guidance concerning the topics to be covered in a document only; no attempt will be made to impose format or content requirements based on military specification practices.

7.5.3 Deviation Policy

Recommended deviations from the IV&V Management Plan are first reviewed and accepted by the PM before they are presented to NASA for approval. The IV&V analyst requesting the deviation must provide a written description of the proposed plan deviation, a rationale for the deviation, and an identification of potential impacts to the IV&V effort (i.e., schedule, cost, quality). Upon acceptance of a recommended deviation by NASA, the IVVMP or lower level plan impacted by the deviation is updated and resubmitted as required.

The Test Buddy is a self-contained, portable test support tool that can also access the IIR. It can be taken to test sites, such as DAACs, and electronically linked to the IIR to download test data sets, test plans, test procedures, and test case definitions. After completion of tests, the test logs, discrepancies, and recorded test data can be ported to the IIR via the Test Buddy.

Further details on the composition of the ISE may be found in the ISE IV&V System Requirements Document delivered on 28 October 1994.

Management of the ISE and its resident tools will be performed in accordance with the procedures detailed in Appendix A: EOSDIS IV&V Tool Management Plan. The EOSDIS IV&V Team approach to specifying, acquiring, integrating, testing, maintaining and using the ISE tools is established in that appendix.

7.4 Performance Assurance and Continuous Improvement

Intermetrics' Continuous Improvement Program (CIP) is important to the overall EOSDIS IV&V methodology. Performance Assurance collected metrics on IV&V performance can be used to mold and improve IV&V methods, tools and procedures. Metrics that address overall performance in terms of time and accuracy are of utility during internal self-assessments to determine areas of improvement and means for streamlining the IV&V process and enhancing its responsiveness. The Performance Assurance function provides a customer perspective when assessing IV&V performance.

Performance Assurance can also identify training programs and materials that would be valuable for correcting any deficiencies in IV&V performance, or for enabling IV&V to stay abreast of changes in the technology base. These recommendations are provided to the EOSDIS IV&V Program Manager and will be used to ensure the program staff stays current.

7.5 Management Policies and Guidelines

7.5.1 Task Iteration Policy

Specific tasks such as requirements traceability analysis, and document and code evaluations require repetition to support changes associated with the Hughes multi-track development process. Tasks will be iterated as necessary based on requirement/design document updates, code modifications, and information identified in the course of IV&V analyses, subject to funding availability constraints.

7.5.2 Standards, Practices and Conventions

In conduct of the EOSDIS IV&V, the Intermetrics IV&V Team will rely on best commercial practices as reflected in IEEE standards and guidelines as the evaluation standard to employ when assessing developer performance. DoD/military standards and specifications will be used for

- Information Tracking Tools
  - -Requirements Traceability Management (RTM) Tool
  - -Discrepancy Tracking System
- Data Base Tools
  - -Relational Data Base Management System
  - -Groupware
- Interface Analysis Tools
  - -Interface Data Consistency/Analyzer
  - -Graphic Communications Interface Analyzer
- Language Environment Tools
- Test Tools (shared with developer and other test agencies)
  - -EOSDIS Test System (ETS)
  - -AM-1 Spacecraft Simulation (SSIM)

This list is preliminary and covers only the initial IV&V tasks. It does however represent the foundation for the Integrated Support Environment (ISE). The ISE consists of an Integrated Information Repository which houses the data bases, the Toolbox which contains the IV&V support tools and the IIR front-end tools, and the Test Buddy which provides remote access to the IIR. The ISE is the backbone of the IV&V effort. It enables visibility into EOSDIS system development as reflected in IV&V products, provides the capability to perform remote site testing, and ensures the flexibility needed to keep pace with technology.

The IIR is the heart of the ISE, holding all the IV&V project data and results, as well as the EOSDIS development information. This repository is accessible to the user community via front-end tools provided by the Tool box. Along with the front-end tools, the Toolbox contains all of the IV&V tools necessary for the IV&V team to complete their task activities. Output products as well as data generated by the tools are stored in the IIR. The tools also retrieve data and products from the IIR when necessary.

The Toolbox compartmentalizes the tools needed to access the IIR, support the IV&V effort, and establish and maintain the ISE. Front-end tools provide user access to data and products stored in the IIR. The IV&V effort is supported by a wide variety of electronic office and technical analysis tools which are integrated to facilitate data sharing. Data storage is separate from tool software, allowing tools to be “plugged in and out”. As long as a tool can access the IIR, it should be able to get needed data. This concept supports technology migration over the EOSDIS project life span. The Toolbox will also house the tools necessary for the ISE support staff to establish and maintain the ISE. This will include the technology migration of the ISE over the EOSDIS life span and access control of the data in the IIR.

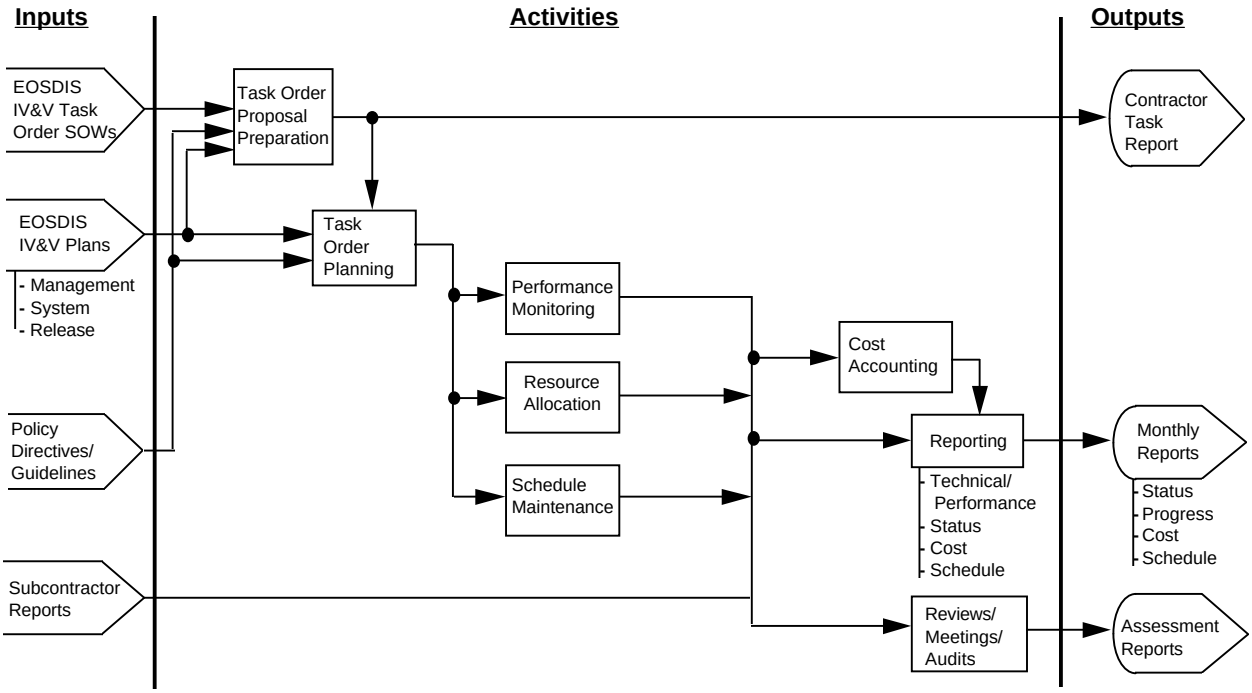

EXHIBIT 7-2: Overall EOSDIS IV&V Management Process Flow

7.3 Tool Management

From analyzing requirements associated with the initial set of IV&V tasks, the following list of tool categories for the EOSDIS IV&V has been developed:

- Office Automation Tools
  - -Word Processing
  - -Graphics
  - -Spreadsheets
  - -Presentations
- Management Tools
  - -Project Tracking
  - -Configuration Management Tools (H/W & S/W)
- Network/Communication Tools
  - -E-Mail
  - -File Transfer Tool

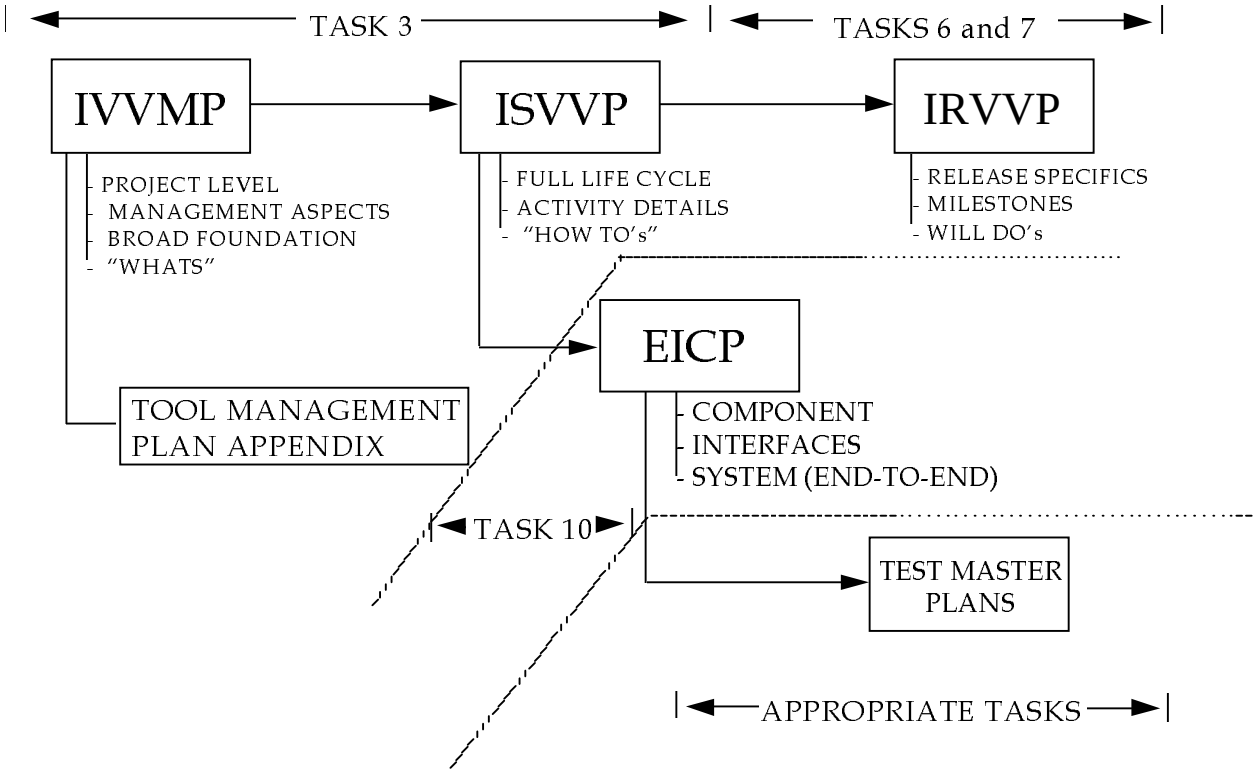

EXHIBIT 7-1. Relationships of Documents in the EOSDIS IV&V Planning Hierarchy

The overall task management process flow is given in Exhibit 7-2. Implementation of the methodology is dependent upon the timely assignment and performance of the work required, as well as the utilization of personnel who have the required technical expertise to carry out the IV&V activities. The process is initiated with a SOW from the GSFC Task Originator (TO) being released by the Contracting Officer (CO) to Intermetrics as a Task Assignment (TA) on GSFC Form 18-5.

Intermetrics' EOSDIS IV&V PM analyzes the TA and, if appropriate, reviews it with the TO to ensure complete understanding of task objectives, scope, and priority. The Program Manager, in concert with the FALs, establishes general directions and scope for the task order and assigns a Task Lead. The Task Lead prepares the Contractor Task Report (CTR), GSFC Form 18-42. Technical reports, including the monthly progress report and the completion report, are generated by the Task Lead, while financial reports are generated by project cost accounting.

Once given authority to proceed, the Task Lead assembles the task team and assigns individual responsibilities to team members to deliver the products and meet the schedule milestones associated with the task SOW. The Task Lead provides both written and oral directions to team members to form a manageable and trackable basis for accomplishing task objectives. The Task Lead has full authority over assigned resources and full responsibility for performance of the task. Progress is tracked and reported against scheduled milestones and assigned budgets. Deviations are brought to the attention of the PM for review and reconciliation.

7. IV&V Management and Administrative Procedures

7.1 IV&V Planning Function

IV&V planning is an on-going activity that establishes directions, sets priorities, and defines tasks, methods and approaches for accomplishing EOSDIS IV&V objectives. EOSDIS IV&V planning is done at multiple levels:

- This IVVMP establishes overall guidelines and directions for the EOSDIS IV&V, defining what methodologies and approaches will be used, and identifying resources available for conduct of the effort.
- The next level in the hierarchy provides the details of the methodologies, defining how specific task activities will be accomplished. There are two plans generated at this level: the ISVVP which covers all EOSDIS life-cycle phase-independent and phase-dependent activities, and the EICP which provides further details concerning EOSDIS in-line test activities.
- The bottom level of the planning hierarchy is the IRVVP, which takes the results of the CARA analysis for that release and provides a specific allocation of resources against release elements across life-cycle activities appropriate to the release.

This IVVMP is updated yearly, or as warranted by changes in available resources or in the nature of the activities to be conducted during IV&V of EOSDIS (i.e., changes in scope). The ISVVP and possibly the EICP would also require updating under these conditions. Multiple issues for the IRVVP are planned; one for each of IR1 and Releases A, B, C, and D, respectively. Updates to individual IRVVPs are not anticipated.

Exhibit 7-1 provides a summary of the EOSDIS IV&V planning document hierarchy and the contents of individual plans in the hierarchy. The Tool Management Plan is an appendix to this IVVMP, defining the structure that will be in place to oversee tool development, acquisition, integration, test and use on EOSDIS IV&V, including configuration management and access controls.

7.2 Task Management

EOSDIS IV&V management methods comprise a closed-loop process consisting of:

- Planning (IV&V Plans at multiple levels with updates),
- Acting (assignment of tasks),
- Reporting (technical, cost and schedule status), and
- Controlling (task oversight).

minimum, all new items added within the reporting period, all currently non-resolved (open) items, and all items closed during the reporting period. The reports contain further breakouts by component, design elements, contractor, etc. as required.

6.2.7 Requirements Traceability Data Bases

The requirements traceability data base is updated as program documentation is received during the development life cycle. At periodic milestones, (see Exhibit 5-18), the data base will be baselined and delivered electronically to the IIR from which it can be accessed by NASA.

6.3 IV&V Progress and Status Reviews

Every second month, the information contained in the Program Status Report (Section 6.1.1) is supplemented with view graphs and presented orally to the EOSDIS IV&V COTR and other NASA, EOSDIS, DAAC, and Prime Contractor representatives as invited by the COTR. These status reviews are planned to be one-half day in duration, including time for discussion. Program, technical and financial status is presented; a restricted subset of meeting attendees will attend financial portions of the briefing.

The agenda for the status review is delivered at least one week in advance of the scheduled meeting date. View graphs are available on the day of the presentation. Minutes from the meeting, including action items and resolution of ongoing program issues, are documented and submitted within 5 working days following completion of the review.

6.2.3 Technical Analysis Reports

The results of specific EOSDIS IV&V activities are documented in Technical Analysis Reports (TARs). These reports provide a summary of significant findings as they relate to EOSDIS and IV&V assessments, along with necessary technical support information. TARs also provide conclusions, significant issues/concerns, and recommendations. Different EOSDIS IV&V task orders utilize the TAR document format for capturing deliverable information. As such, the general TAR format is tailored to the specific needs of the individual activity; formats are specified in preliminary form in the ISVVP. For example, the TAR documenting the results of an analytic study/impact analysis is structured differently from a TAR giving the results of a document review.

6.2.4 Review Item Discrepancies

At formal program review milestones, the Intermetrics IV&V Team drafts, in approved format, and submits Review Item Discrepancies (RIDs) in accordance with published NASA instructions for that review.

6.2.5 Test Documentation

For each component key interface and system test conducted by the EOSDIS IV&V Team, a set of test documents is generated and delivered to the EOSDIS IV&V COTR. Documents in this set include:

- Test Plans and Procedures delivered in draft and final versions. Draft versions are delivered sufficiently in advance of the scheduled test date to enable review and comment by interested parties/agencies. Final versions are due in advance of scheduled testing.
- Test Logs and Discrepancy Reports, delivered as soon as possible following completion of the tests. The test logs provide a complete audit trace of what occurred during test conduct and the DRs are used to document anomalies detected during test.
- Test Reports summarize the results from the post-test analysis effort. These include a delineation of which requirements were validated by the test, and which requirements slated for validation, were not qualified, and why.

6.2.6 Tracking Data Base Status Reports

The IV&V contractor creates, populates, and maintains a variety of EOSDIS tracking data bases encompassing program issues, Nonconformance Reports (NCRs) from the development contractors, DRs from integration and certification testing, RIDs from formal progress reviews, and action items from technical interchange meetings. Selected portions of these data bases will be summarized and reported in hard copy format on a monthly basis. Summaries include, at a

the events occur, and include a discussion of the impact the actions of the IV&V Team have had on EOSDIS program activities.

6.1.4 Performance Assessment Summary

Prior to each award fee evaluation activity, the EOSDIS IV&V Team prepares and submits an IV&V Performance Assessment Summary for all activities during that period. This report will be a summary of all activities and accomplishments completed during the award fee period, with particular emphasis on deliverables, support to program milestones, and the completion of major IV&V phase-dependent support activities as described in Section 5.2. Major issues and concerns identified by the EOSDIS IV&V Team are also summarized in this report, and IV&V team actions and recommendations in response to these risks and concerns are reviewed.

6.2 Technical Reports

6.2.1 IV&V Plans

The EOSDIS IV&V approach is documented in an organized hierarchy of IV&V plans. The first of these documents is the current plan, referred to as the IV&V Management Plan (IVVMP). This plan presents activities at a program overview level, defines the overall approach, and identifies the principal IV&V activities. It also focuses on the IV&V environment, resources, and tool concepts. The next subsequent plan in the hierarchy is the Independent System V&V Plan (ISVVP), which describes the detailed IV&V approach and explains how the activities comprising the IV&V methodology will be conducted. The lowest level of the hierarchy is occupied by the Independent Release V&V Plan (IRVVP), which details the specific activities and resources to be employed for conducting IV&V of a particular EOSDIS component release. The IV&V EOSDIS Integration and Certification Plan (EICP) details the activities performed during the testing phase. It provides insight and details concerning the multi-level test program that will be conducted as part of the certification process.

EOSDIS IV&V plans will be updated yearly, or as required, to document necessary changes to the software IV&V approach. This IVVMP follows the content and structure guidelines given in the IEEE Standard for Software Verification and Validation Plans (IEEE Std 1012-1986). Lower-level plans will use IEEE Std 1012-1986 as guidance, but will deviate in areas where more detail on specific activities is necessary.

6.2.2 CARA Results

Following completion of a CARA, the results and attendant recommendations for actions and focusing of efforts will be provided to the COTR in report format. This report will detail the type of CARA performed, the factors and criteria employed in the review, and the resultant ordering of the items assessed. Recommended actions will include alternatives and priority indices to facilitate subsequent decision making processes.

6. Software V&V Reporting

The EOSDIS IV&V provides numerous products including technical reports, progress reports, financial analyses, and requirements trace data bases to facilitate the transmittal of administrative and technical status information, performance assessments, and IV&V analysis results. The following sections discuss the general content, format, and timing for classes of IV&V reports, all of which are deliverable to the IV&V Contracting Officer Technical Representative (COTR), Code 505, EOSDIS Project Office.

Reports will be delivered in hard copy format with an electronic version available on floppy disk. Electronic media will be IBM-PC or Macintosh compatible using Microsoft Office word processing utilities (Word, Excel, and Power Point).

The EOSDIS IV&V Team will also maintain a reference library of all document deliverables generated by the team. All IV&V data products and reports will be in the IIR, at Fairmont, West Virginia, and may be electronically accessed by the EOSDIS Project Office.

6.1 Administrative Reports

6.1.1 Program Status Report (Monthly Progress Report)

The Program Status Report (PSR) presents the programmatic, financial, and technical status of the EOSDIS IV&V program on a monthly basis. Each technical task currently active on the contract is discussed with respect to significant activities and task accomplishments performed during the previous month, as well as planned activities for the next performance period. In addition, a status of problems/issues, identifying resolutions to previous problems/issues, and any new problems/issues along with proposed solutions, is contained in the report. The PSR also reviews budgetary and manpower expenditures on a task-by-task basis with regard to actual versus planned resource outlays. This report is prepared and submitted by the 15th day of each month.

6.1.2 Financial Reports (533M and 533Q)

NASA 533 series of reports is submitted both monthly (533M) and quarterly (533Q) in accordance with Instruction NHB 9501.2B, entitled "Procedures for Contractor Reporting of Correlated Cost and Performance Data."

6.1.3 Significant Event Reports

Significant Event Reports are prepared and submitted to the COTR. These reports identify significant events and accomplishments during the award fee assessment period that warrant consideration by the review board during its award fee determination process. They are issued as

	TASKS										
METHODS/TECHNIQUES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
5.1.1 Traceability					XX	XX	XX	XX	XX		XX
5.1.2 CARA			XX				XX	XX			
5.1.3 Discrepancy Handling				XX			XX	XX	XX		XX
5.1.4 Configuration Control				XX					XX		XX
5.1.5 Documentation Review					XX	XX	XX		XX		
5.1.6 Formal Review Support					XX	XX	XX		XX		
5.1.7 Studies/Analyses				XX	XX	XX	XX	XX	XX	XX	XX
5.2.1 Concept Phase				XX	XX				XX		
5.2.2 Requirements Phase				XX	XX				XX		
5.2.3 Design Phase				XX		XX	XX				
5.2.4 Implementation Phase				XX		XX	XX				
5.2.5 Testing Phase				XX				XX			XX
5.2.6 Install/Checkout Phase				XX				XX			XX
5.2.7 Ops/Maintenance Phase				XX							
6.1 Administrative Reports	XX	XX									
6.2 Technical Reports			XX	XX	XX	XX	XX	XX	XX	XX	XX
6.3 Progress/Status Reviews	XX	XX									
7.1 Planning			XX			XX	XX			XX	
7.2 Task Management	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
7.3 Tool Management	XX		XX								

EXHIBIT 5-19. Allocation of IV&V Methodologies to Initial Tasks

EXHIBIT 5-18. Milestone Schedule for Initial Set of IV&V Tasks

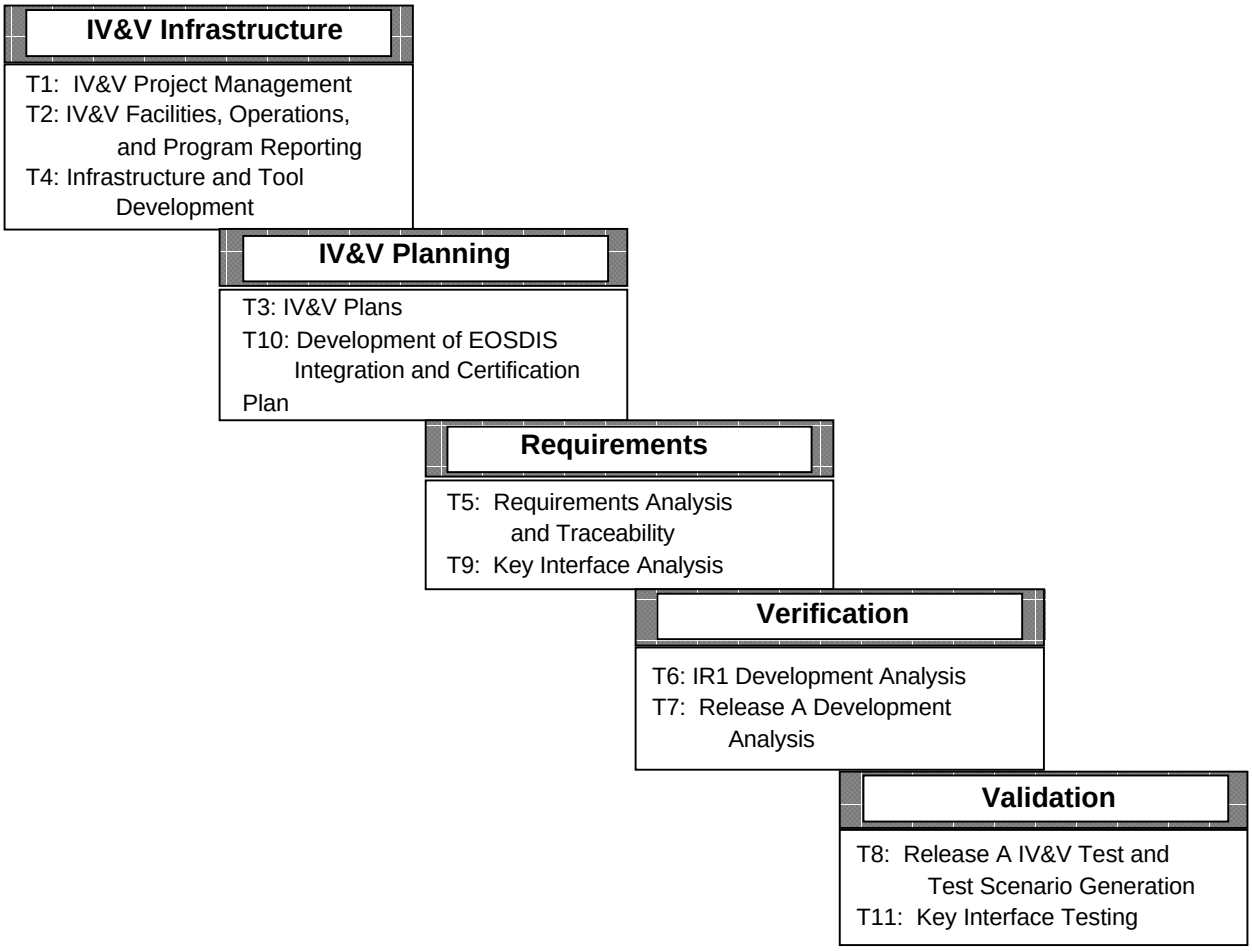

EXHIBIT 5-17. IV&V Categorization of Initial Tasks

Exhibit 5-19 provides an allocation of the IV&V methodology building blocks defined in Sections 5.1 and 5.2, milestone reports and deliverables defined in Sections 6.1, 6.2, and 6.3, and management techniques described in Sections 7.1, 7.2 and 7.3 of this IVVMP across the initial task set for EOSDIS IV&V. This allocation identifies which methodologies will be employed in the performance of the individual task by reference to the section number in which the methodology is described.

tasks on the EOSDIS IV&V task ordering contract. Under this contract, NASA GSFC determines specific tasking requirements and issues SOWs for their accomplishment. The IV&V Team responds to the SOWs and, after agreement on approach and costs, undertakes the tasks. The open IV&V tasks at any given point in time have an individual and unique composition (i.e., the tasks at one point differ from those at other points in time). This provides tasking flexibility and the ability to refocus IV&V short term resources. Because of the potential instability of the tasks, this also limits the ability to structure and plan the longer term IV&V effort. This is one of the principle reasons for the hierarchy of IV&V plans for EOSDIS. The hierarchy enables this plan to describe the broad general approach, while lower level plans provide task order specifics.

Even though the specific tasks over the life of the EOSDIS IV&V contract cannot be predicted with certainty, tasks can be characterized as falling into one of five broad categories:

- IV&V Infrastructure - including program management, business operations (facilities, computer resources, etc.), and the development and maintenance of IV&V tools.
- IV&V Planning - including tasks specifically directed toward the generation of plans covering multiple aspects and time frames associated with the IV&V effort.
- Requirements - including tasks directed toward analyzing, tracking and assessing EOSDIS requirements.
- Verification - including tasks directed toward life-cycle verification activities spanning the concept, requirements, design and implementation phases as defined in Section 5.2.
- Validation - including tasks directed toward certifying the performance of EOSDIS and its constituent components, elements and interfaces.

The initial set of tasks defined for the EOSDIS IV&V comprises 11 tasks, seven of which are currently open (i.e., active). These tasks are categorized in terms of the above taxonomy in Exhibit 5-17. The span of these tasks encompass ECS IR1 and Release A, but does not entail IV&V for EDOS or Ecom. EDOS related tasking will be added (a Task 12 covering early life-cycle EDOS has been defined). Ecom (which has a separate IV&V effort defined for it) is planned to come under EOSDIS IV&V cognizance during Testing Phase activities.

Exhibit 5-18 provides the milestone schedules for Tasks 3 through 11. Tasks 1 and 2 span the entire contract time frame and include milestones associated with periodic reporting of status, progress and accomplishments. For space considerations they are not included in the exhibit because of the repetitiveness of the milestones. The four defined tasks not currently open are all scheduled to be initiated during the 1995 Government fiscal year.

changes), design assessment, implementation monitoring (analysis of system performance), integration and test, and installation and checkout. It however has a much narrower scope (engineering change proposals vice entire systems), and executes over a much condensed time-frame (measured in months instead of years).

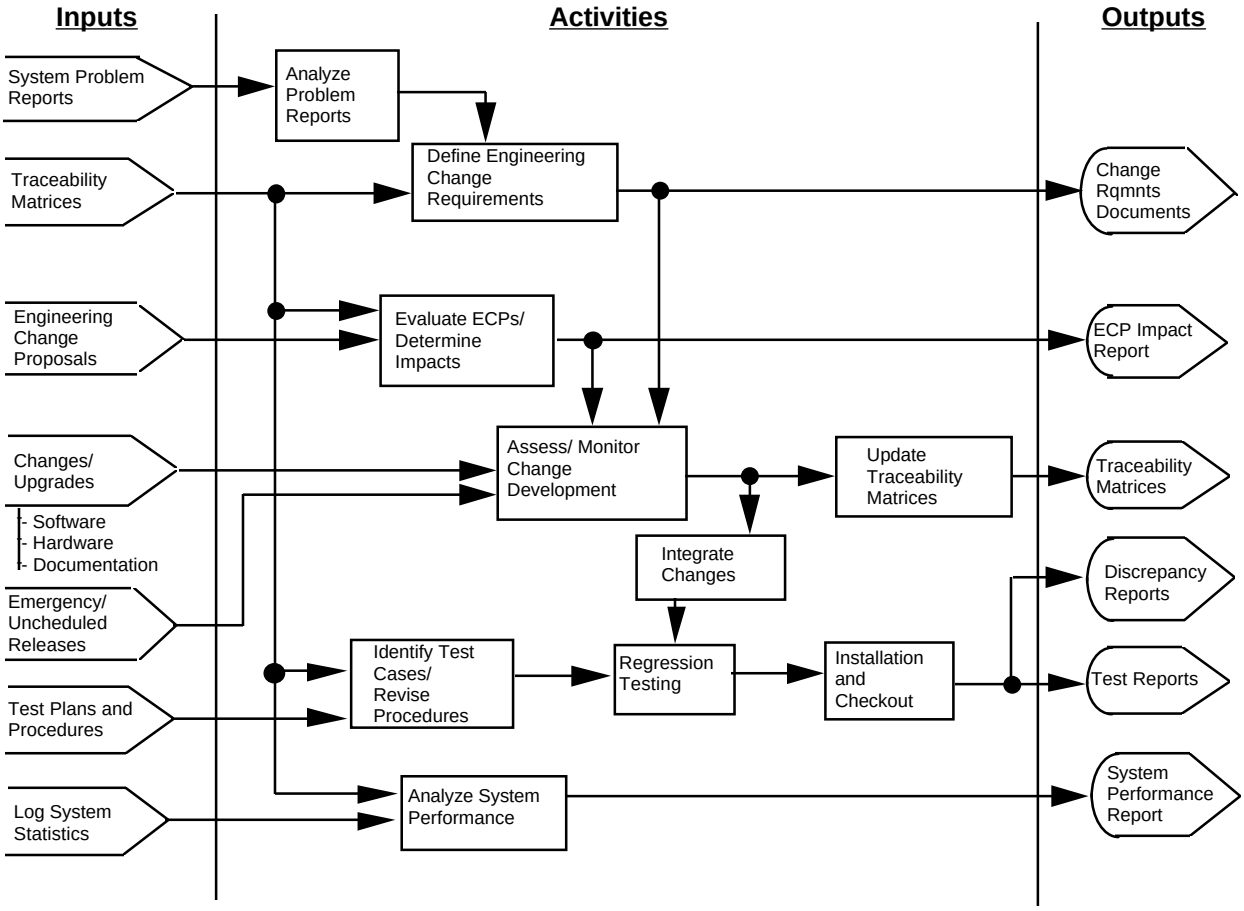

EXHIBIT 5-16. Operations and Maintenance Activity Network

The basic IV&V methodologies used are descoped variations on the standard methodologies employed during initial system development, and include maintenance of the traceability matrices. These matrices are essential inputs during this phase. They are used to assess impacts of proposed requirements and engineering changes, and as a means for determining what testing is required to evaluate changes at the test case level.

5.3 EOSDIS IV&V Initial Task Structure

The materials in Sections 5.1 and 5.2 above define the methodology "building blocks" the Intermetrics IV&V Team employs during the course of the EOSDIS IV&V. These building blocks enable a systematic and common approach to the objectives associated with individual

Post-test analysis and reporting analyzes the results data in accordance with instructions in the approved analysis plans. Problem reports for anomalies uncovered during analysis are written and the final Test Report is prepared. The Test Report provides a summary assessment of the readiness of the system under test to support EOSDIS mission operations, documents problems uncovered, and identifies any deviations from approved procedures.

5.2.6 Installation and Checkout Phase

Objectives of the Installation and Checkout Phase IV&V are to monitor and assess the installation process and to certify the integrity of the configuration. The process methodology to meet these objectives is given in Exhibit 5-15. The Intermetrics IV&V Team provides review and assessments at each step of the installation process to ensure an orderly and timely progression through scheduled milestones. The configuration items comprising each component will be verified at installation to ensure that only fully-qualified components and elements are installed. Summary reports will be prepared and delivered following completion of these activities.

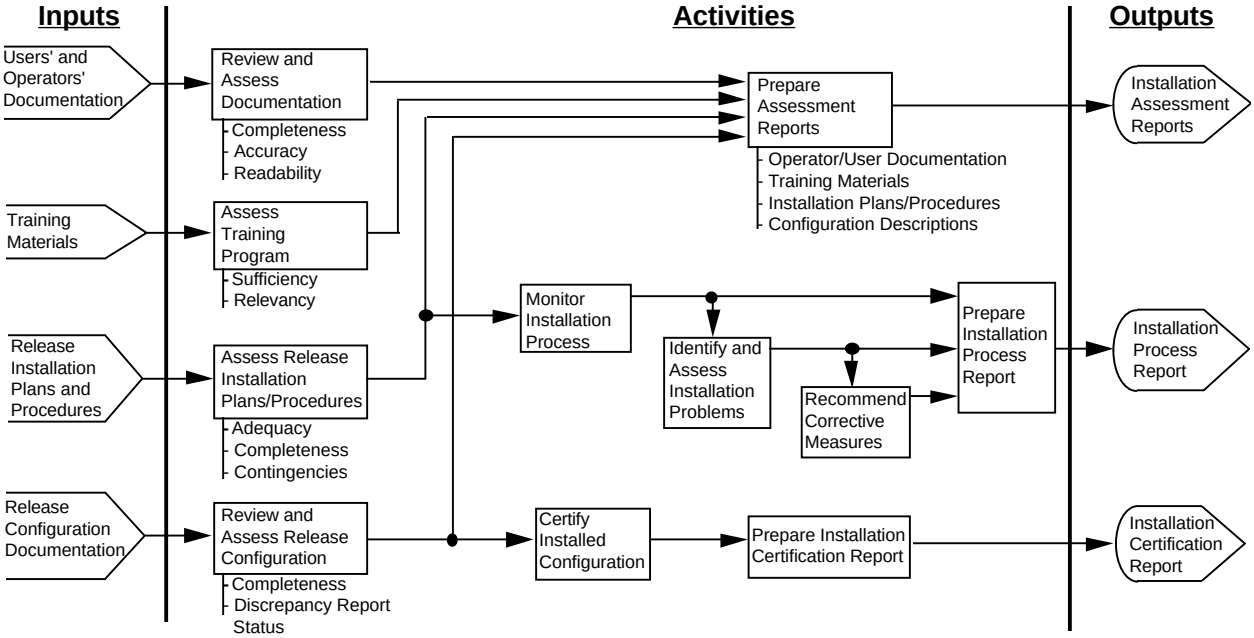

EXHIBIT 5-15. Installation and Checkout Activity Network

5.2.7 Operation and Maintenance Phase

The objective of Operations and Maintenance Phase IV&V is to provide life-cycle support for on-going operation of EOSDIS. As illustrated in Exhibit 5-16, IV&V activities during the Operations and Maintenance Phase constitute a microcosm of the software development life cycle, focused on engineering changes to the baselined EOSDIS. This life cycle includes all the traditional phases: concepts (engineering change proposals), requirements analysis (requirements

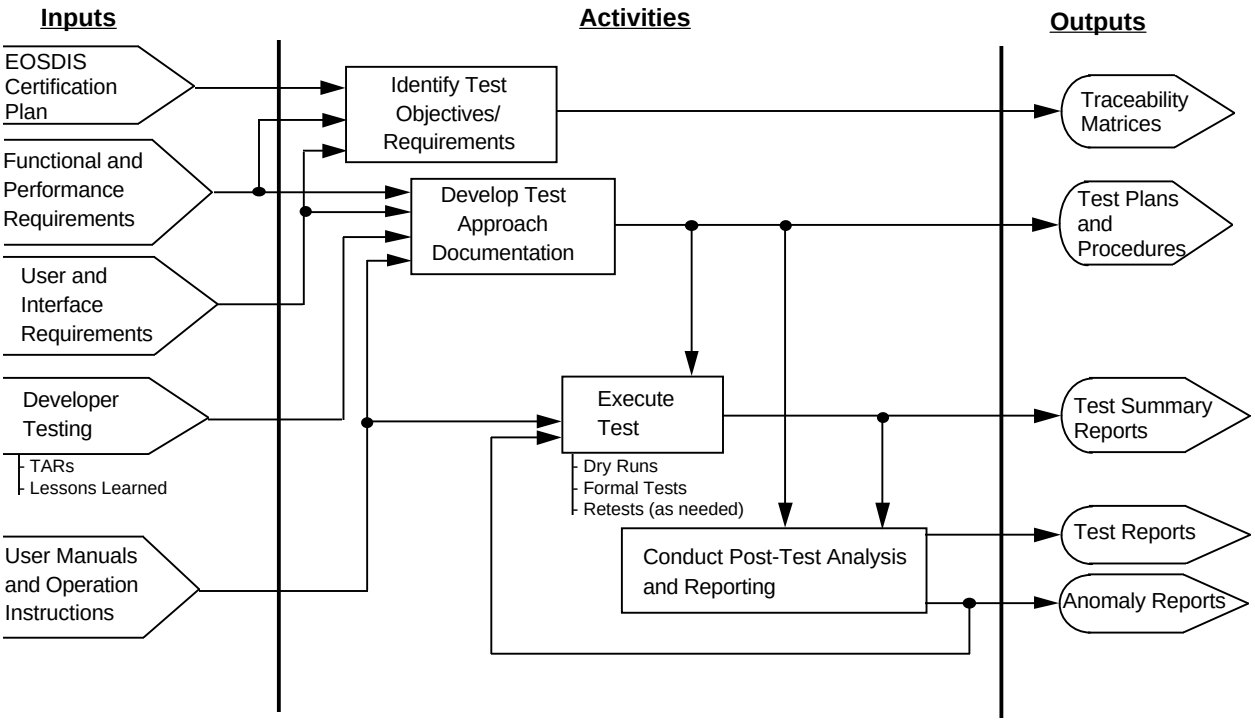

EXHIBIT 5-14. Testing Activity Network

Identification of test objectives and requirements is based on the EICP, Functional and Performance Requirements (F&PR) documentation, and design documentation, and establishes the specific set of requirements to be evaluated by the Intermetrics IV&V Team. The process is supplemented by the traceability activity, as defined in Section 5.1.1, which links requirements to specific test levels and cases. The resultant traceability matrices are used to ensure that all requirements are thoroughly tested.

Test approach documentation includes test plans, test procedures, and analysis plans for each test. The Test Plan defines the specific test support requirements and test data characteristics, and provides an overview test description. The corresponding Test Procedures document specifically identifies test data sets, provides step-by-step execution procedures, and defines expected results and acceptance criteria for each test event. Analysis plan appendices specify the procedures for conducting post-test analysis, including the required data and any algorithm or data reduction necessary to verify the test results. The analysis plan appendix also outlines procedures for evaluating anomalies discovered during the test and/or analysis of the test data.

Tests are conducted by the Intermetrics IV&V Team in accordance with approved test procedures. Test dry runs are used to validate test procedures and data collection methods. Test and retest (as necessary) sessions are formally witnessed, summary or "quick-look" results reported, and data collected for post-test analysis. Problems detected during test execution are reported immediately via DRs.

- Regards certification as a culmination of a variety of processes used to qualify EOSDIS performance including inspections, demonstrations, analyses, and tests, and
- Relies on a progression of testing levels ranging from tests of stand-alone components, to key interface testing, to testing of integrated strings (sequences) of interfaces, to end-to-end system testing of data flows and operational performance.

Component-level testing evaluates the F&PRs associated with individual ECS, EDOS and Ecom component releases. The principal objectives are to validate that the various elements within each component are compatible with each other, and that each component complies with the allocated functional and performance requirements.

Key interface testing begins with evaluations of single interfaces, followed by evaluations of progressively more complex combinations of interfaces, leading up to end-to-end testing of system threads/strings. Objectives include validation that each interface meets its functional and performance requirements, supports EOSDIS operational scenarios requiring transmission of data across that interface, and works in concert with other interfaces without any degradation in performance.

System-level testing is a natural continuation of key interface end-to-end tests, using representative mission scenarios and data throughput rates to validate that the fully integrated EOSDIS meets the F&PRs, including its ability to support the science user community. System-level testing is only conducted on those releases intended to support operation of EOSDIS satellites.

An approach for certifying EOSDIS functionality and performance is provided in the EICP which defines the various testing levels, and describes how they contribute to the overall certification process. The EICP details the progressive build-up in complexity associated with the layered integration approach being taken. Component certification validates delivered functionality for the individual releases. Key interfaces are both inter- and intra-component, and are identified as such because of their criticality, complexity and centrality for successful EOSDIS operations. As more and more components and elements are integrated, strings become functional (e.g., the transfer of data from White Sands to Fairmont and on to the DAACs) and are validated. String testing extends beyond mere validation of the interface, it also certifies the correct functionality of each node in the string (continuing the example, correct generation of the Level 0 data sets would be validated). Sufficient integration is eventually accomplished so that entire logical segments of the EOSDIS are in place and functional (e.g., data ingest and routing logical segment, science operations logical segment, flight operations logical segment, etc.). At these milestones, end-to-end system testing is accomplished, and the functionality and performance of the logical segment is certified. The EICP includes Master Test Plans for the component, key interface, and system levels of EOSDIS testing.

Testing at each stage of progressive integration can be accomplished utilizing a common approach methodology. The same basic set of activities are completed regardless of the level of testing being performed. This underlying methodology consists of the sequence of activities identified in Exhibit 5-14.

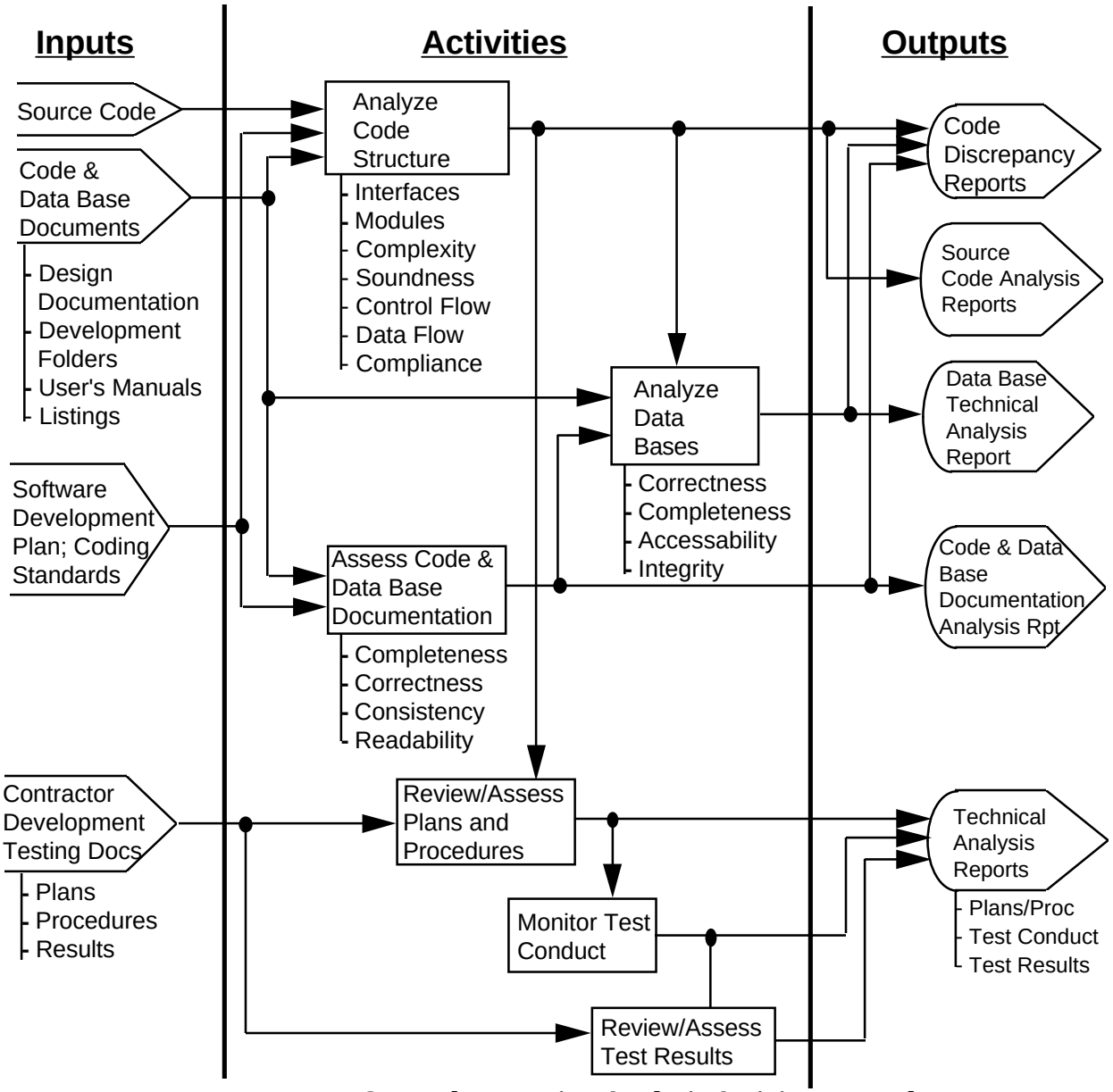

EXHIBIT 5-13. Implementation Analysis Activity Network

5.2.5 Testing Phase

Objectives of the Testing Phase IV&V are to certify that EOSDIS Level 2 and 3 Functional and Performance Requirements (F&PRs) allocated to a release are satisfied, and to certify that all components (ECS, EDOS, Ecom) and key interfaces function together correctly to yield desired EOSDIS operability. These objectives are much broader in scope than those usually associated with IV&V testing. Traditionally, IV&V testing is confined to independent, redundant testing of specific aspects of the system. EOSDIS IV&V testing will be conducted in-line, as part of the overall development effort. The Intermetrics EOSDIS IV&V team will satisfy these objectives using an approach that:

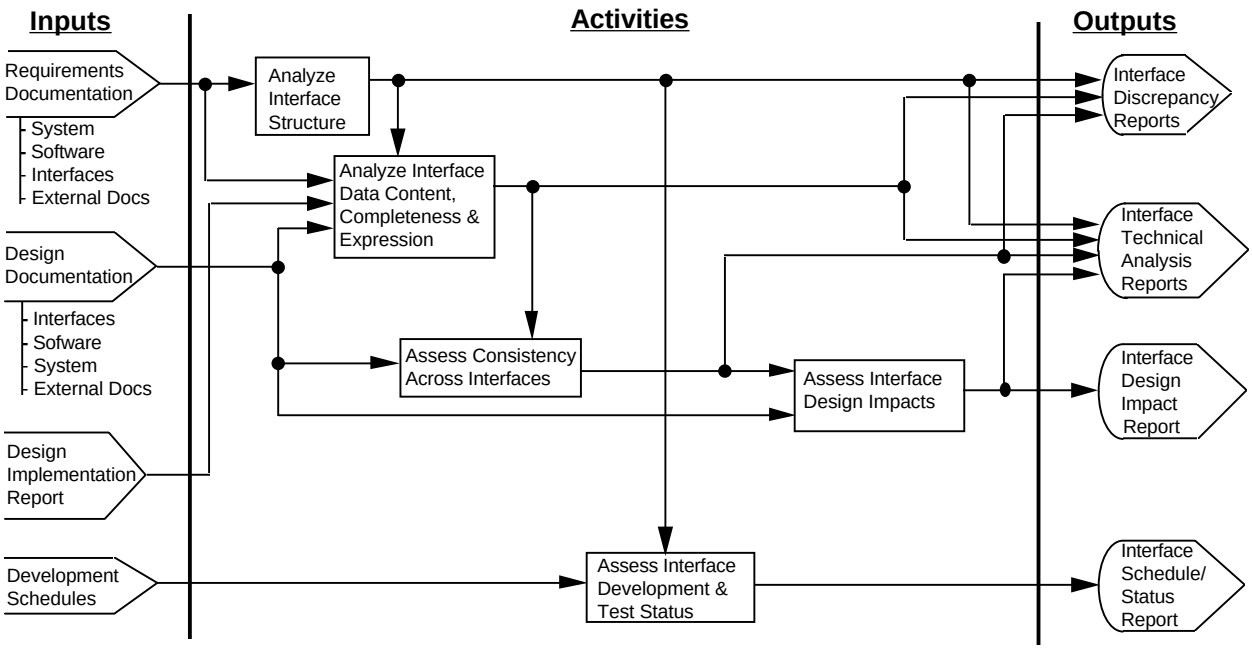

EXHIBIT 5-12. Interface Analysis Activity Network

5.2.4 Implementation Phase

Objectives of Implementation Phase IV&V are to verify that developed code mechanizes the design, and to assess the sufficiency of the testing process to which code is subjected during the developer's software development process. Traceability is extended to the code structure level, and test cases are linked to the requirements during this phase in accordance with the methodology given in Section 5.1.1. Phase specific activities are summarized in Exhibit 5-13.

The top portion of the exhibit identifies the major processes that are part of the code verification effort. These include analysis of the code structure versus the design, analysis of the data bases and assessment of the documentation. All aspects of the code implementation are subject to scrutiny during this phase, including the procedures employed as specified in the Software Development Plan (SDP), and the technical details reflected in the contents of the Software Development Folders (SDFs).

The lower portion of the exhibit details the steps that are followed when assessing the development contractor's testing. In essence, IV&V serves as a monitor and watchdog over this process; reviewing plans and procedures for completeness and appropriateness, watching test conduct to ensure proper conduct and recording, and reviewing results documentation for accuracy and scope of coverage provided by the test program. IV&V monitors all formal testing performed by the developer prior to delivery to NASA. For ECS, this includes segment testing, system integration testing, and acceptance testing performed by the IATO. For EDOS, it includes development integration testing, system integration testing, and developer functions and performance testing.

Reports are generated documenting design issues that can potentially impact other system elements (e.g., interfaces).

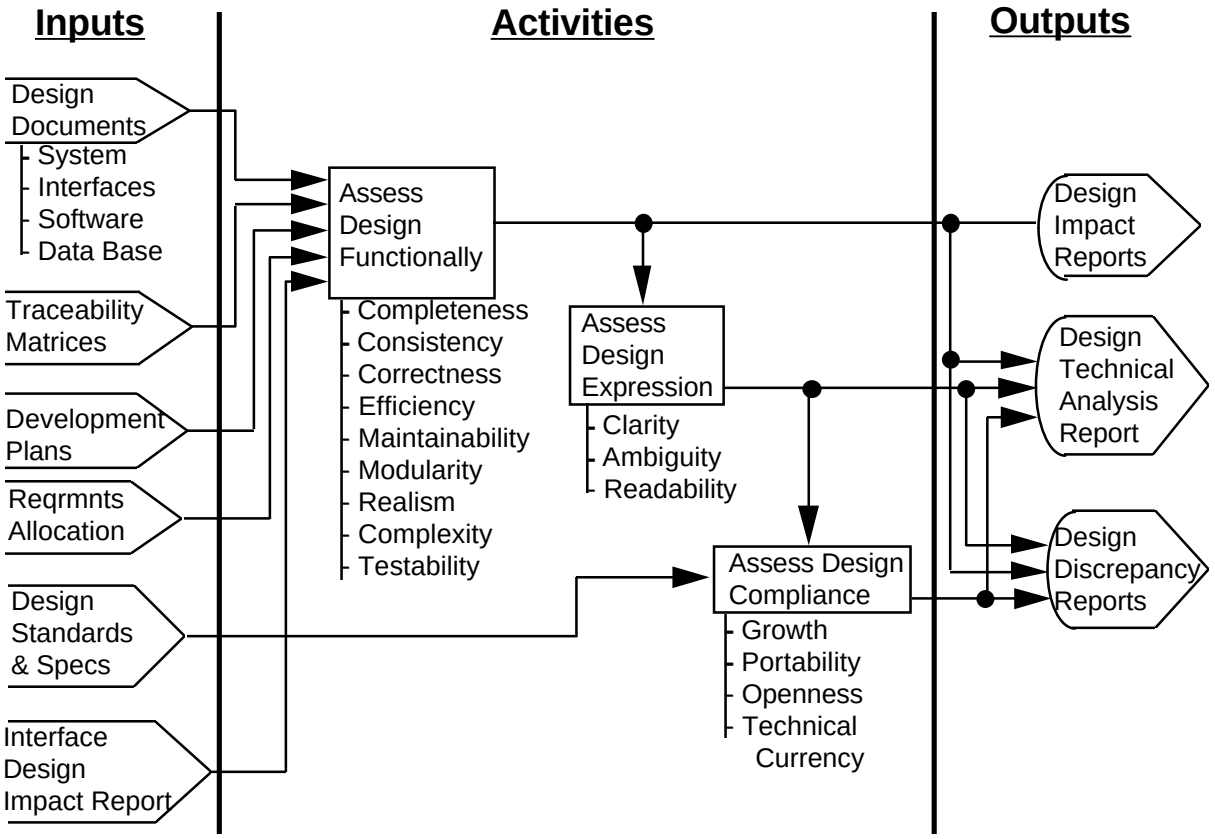

EXHIBIT 5-11. Design Integrity Activity Network

The methodology for attaining the last of the Design Phase IV&V objectives, interface viability, is illustrated in Exhibit 5-12. Standard IV&V practices would treat the interfaces as one element of the design. However, because of the large number of interfaces in EOSDIS and their criticality for overall system functionality, the IV&V Team has elected to elaborate the interface analysis methodology separately. This methodology includes full analysis of the structure, data content and functionality of the interfaces and includes provisions for assessing consistency across multiple (chained or sequentially linked) interfaces. TARs, DRs, and Interface Design Impact reports are generated as appropriate to present the results of these analyses. The Interface Design Impact Report in particular attempts to capture issues that may have a broader impact on other system elements. The multiplicity of interfaces, and the potential for logistical problems associated with coordination of testing on EOSDIS, led to the inclusion of a status assessment activity in the interface analysis methodology. Also during this phase, traceability is extended from the requirements to the design elements satisfying the requirements in accordance with the methodology presented in Section 5.1.1.

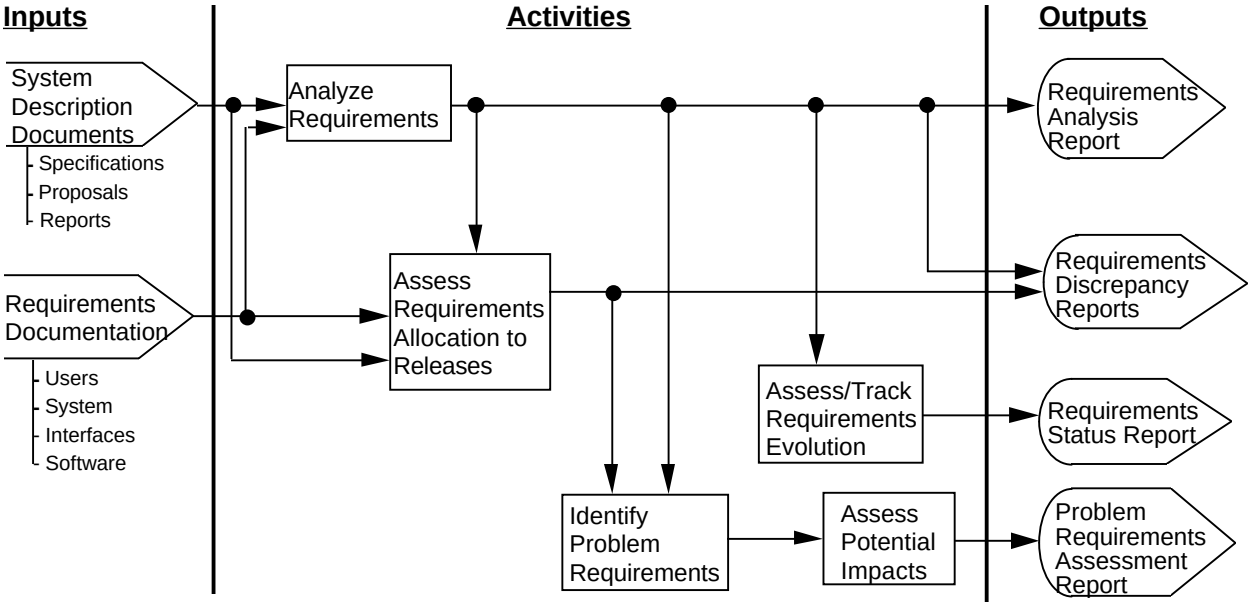

EXHIBIT 5-10. Requirements Phase Activity Network

A structured methodology is employed for assessing element and interface requirements. Requirements are analyzed for technical integrity, criticality, risk and conflict with programmatic constraints (e.g., need dates, operational environment considerations, etc.). The allocation of requirements to the release at hand is verified to ensure a complete set of requirements, consistent with intended use of the release. Results are documented in Technical Analysis Reports and/or DRs as appropriate.Requirements analysis is an on-going process for EOSDIS because of the emphasis on accommodating growth and the need to continually evolve against changing science user scenarios. The latter consideration in fact represents one of the more significant challenges for EOSDIS IV&V. Science user technical requirements and demands for services are not well documented nor entirely known; unforeseen events can cause a dramatic shift in the requirements base (e.g., a volcanic eruption or similar occurrence). The existence of the requirements tracking data base and the systematic methodology Intermetrics has in place for performing requirements analyses mitigates this challenge.

5.2.3 Design Phase

IV&V objectives associated with the Design Phase are to assess the functionality of the design, the soundness of its expression in documentation, and the viability of its interfaces. The first two of these objectives are satisfied by the design integrity activity network illustrated in Exhibit 5-11.

The design is assessed with respect to well-defined criteria associated with its functionality, with its documentation, and with its ability to support evolution and growth requirements. Attention is given to both the design expression and its compliance with standards, because these are the foundation for software coding, and experience shows that confusion/misinterpretations during the hand-off from design to implementation to be a major source of errors. Design Impact

difficult to assess when the involved elements are at different maturity levels. Existence of well-defined methodologies, and an IV&V staff trained in their use, enables the Intermetrics EOSDIS IV&V Team to quickly adjust its focus between the differing maturity levels, and to properly account for the impact that this has on analysis and test results.

5.2.1 Concept Phase

IV&V objectives of the Concept Phase are to identify design concepts, develop an understanding of the technology base needed to develop these concepts, and lay the foundation for mitigating program risks. IV&V activities during the Concept Phase complement these objectives as illustrated in Exhibit 5-9. The IV&V focus is on assessing the ability of the developer to nurture the design concepts to maturity without exposing the program to unacceptable risk levels. EOSDIS IV&V will provide an unbiased perspective during this early phase, which can serve both to alert the developer to potential difficulties/pitfalls, and to identify areas on which to concentrate IV&V efforts during subsequent phases of the development.

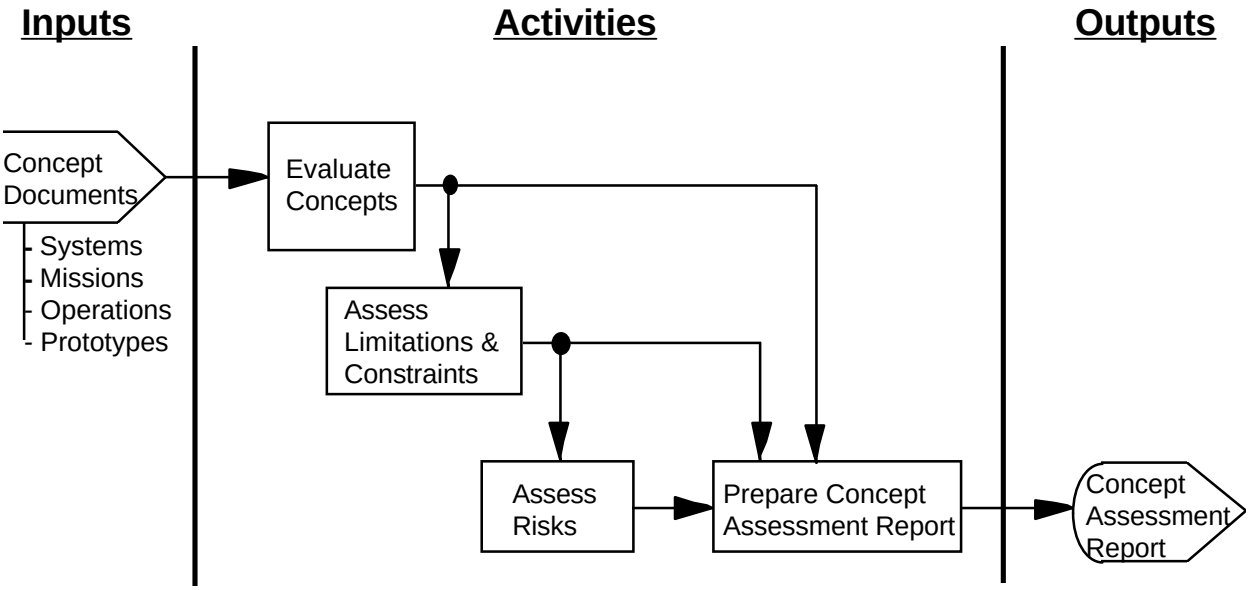

EXHIBIT 5-9. Concept Phase Activity Network

5.2.2 Requirements Phase

IV&V objectives during the Requirements Phase of development of EOSDIS elements are to establish the requirements hierarchy and linkages, verify the soundness of the results of the developer's requirements engineering process, and to identify requirements that are likely to represent challenges or problems for the developers. The first of these objectives is met through the traceability activity as described in Section 5.1.1. The remaining objectives are embodied in the phase-specific activities detailed in Exhibit 5-10.

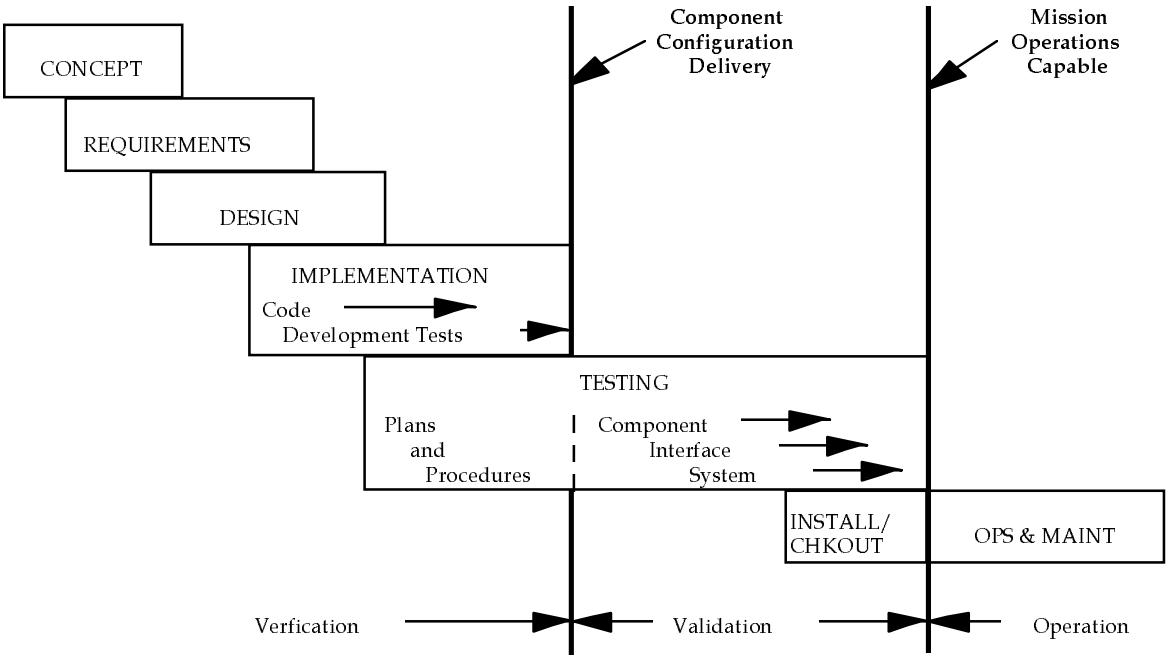

EXHIBIT 5-8. EOSDIS Life-Cycle Model and IV&V Stages

- Testing - the planning, conduct and documentation of tests across a series of progressively higher levels of integration extending from stand-alone components to interfaces to strings to the fully integrated EOSDIS. This phase is performed by the IV&V and Integration Teams in concert with NASA.
- Installation and Checkout - IV&V of the integrated system in its operational configuration and environment.
- Operations and Maintenance - entails preserving and enhancing the delivered performance of EOSDIS, and facilitating science user community access to EOSDIS data and products.

From the IV&V perspective, this life-cycle model is partitioned into three parts as indicated. Verification encompasses the first four phases of the life cycle, ending with the system configuration delivery milestone at which a component release for ECS, EDOS or Ecom passes from being the developer's responsibility to being the responsibility of the NASA EOSDIS project. Validation extends from this point through the Testing Phase and the Installation and Checkout Phase, culminating in establishment of an MOC associated with deployment (launch) of a satellite. Operation of the system follows the MOC milestone.

Superimposed on this basic model is the Hughes multi-track development process, which means that during verification individual elements of the same ECS release can be in different phases of the development cycle (e.g., one may be in design, while another may have completed module-level testing). This is an added complexity for IV&V because interfaces and interoperability are

two phases of implementation and testing. The Implementation Phase is a composite of code and development testing and includes all testing performed by, or on behalf of, the developer (including IATO acceptance testing). The Testing Phase encompasses system integration and test, and includes all certification activities performed by the IV&V contractor.

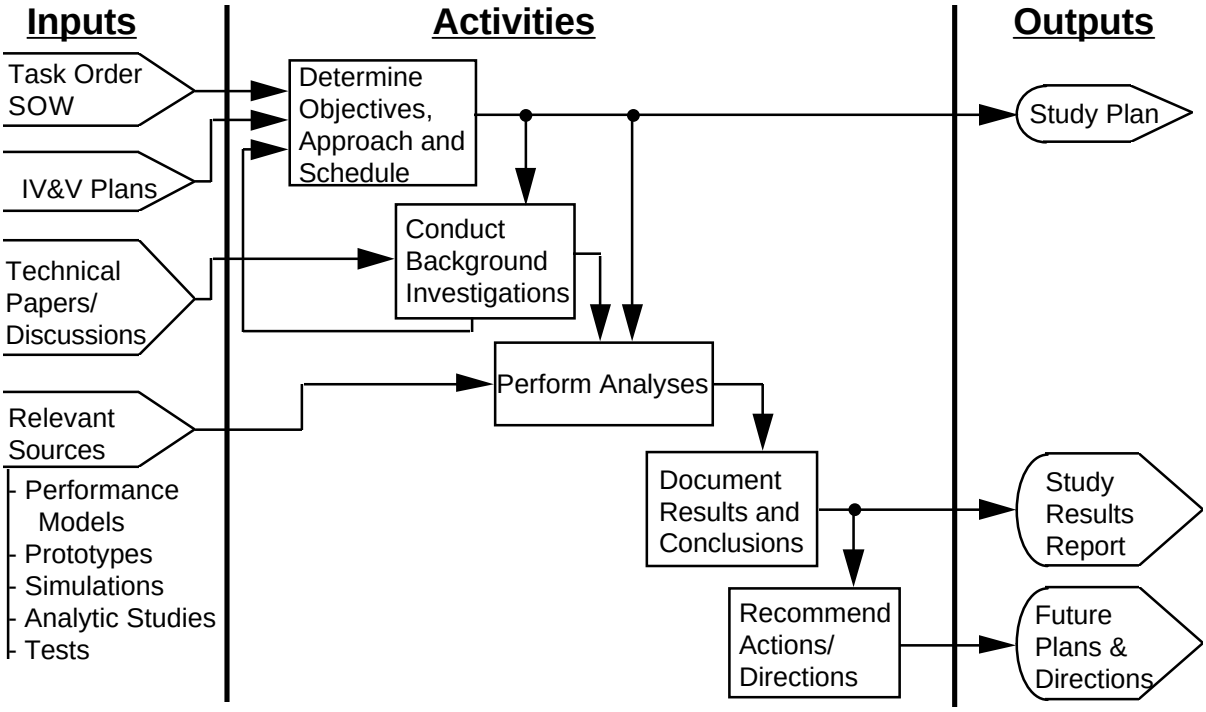

EXHIBIT 5-7. Special Studies Activity Network

It is entirely possible that to be completely accurate, different segments of the overall EOSDIS may require individualized life-cycle models. For instance, Exhibit 5-8 may accurately depict the flight operations perspective, while a science operations perspective may initiate the Operations and Maintenance phase prior to the Mission Operations Capable (MOC) milestone. This issue may be important for EOSDIS certification, and if so, will be further addressed in the EICP.

This life-cycle model given in the exhibit consists of seven distinct phases:

- Concept Development - concepts, technology base and system architectures are identified and analyzed.
- Requirements - engineering and design studies are performed to determine the soundness of the requirements and the best means for satisfying them.
- Design - design elements are finalized and the architecture iterated to provide a basis for building the system.
- Implementation - includes the system build (coding) and the development testing of units, modules and configuration items. This phase includes all testing performed by the developer and his agents.

of the design, depending on the needs of the EOSDIS program. The impetus for such studies can come from any verification activity, but most commonly arises from questions raised during the document review process.

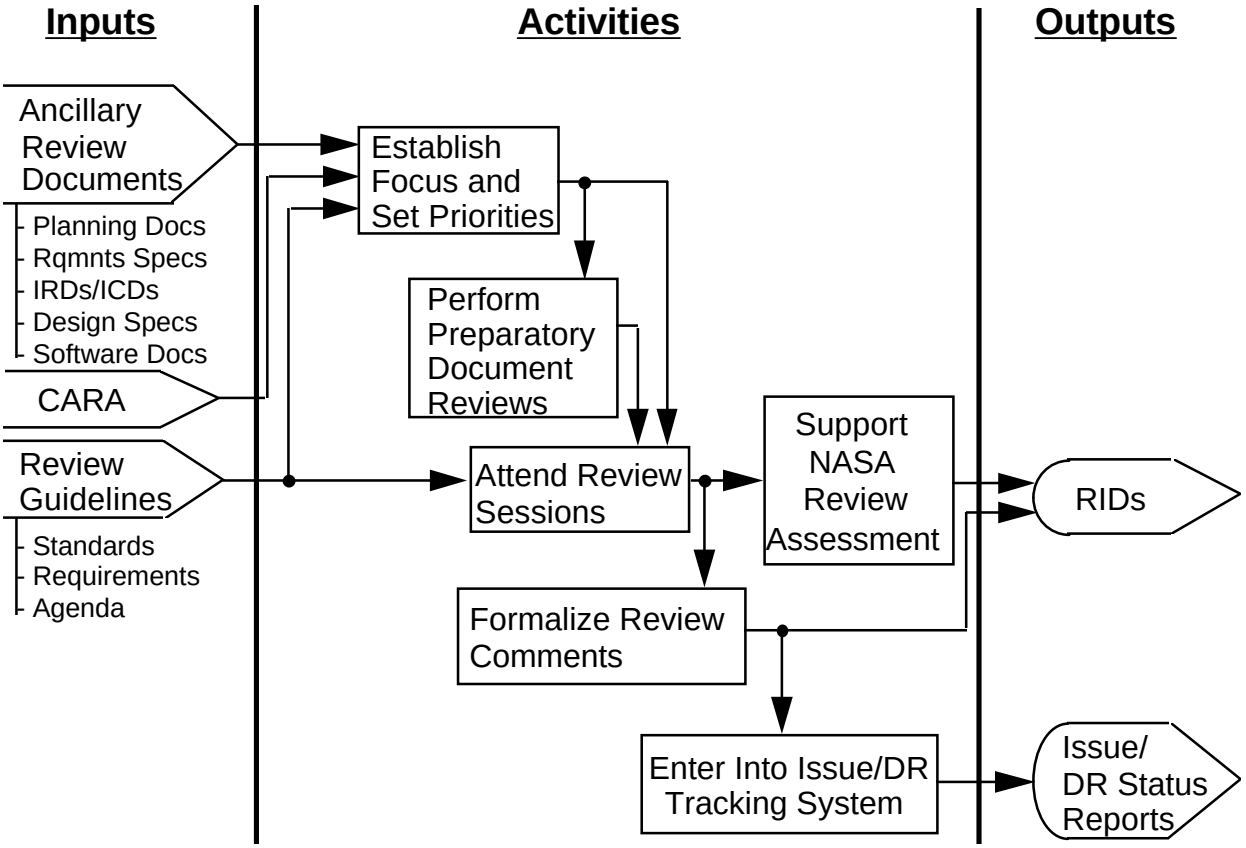

EXHIBIT 5-6. Program Review Support Activity Network

Exhibit 5-7 provides a general methodology for analytic studies/impact analyses that is easily tailorable to encompass all situations that are likely to arise during the course of the EOSDIS IV&V. Noteworthy features of this methodology are the early attention given to defining the objectives and approach (and documenting them in a Study Plan), and recommendations for future courses of actions based on results provided at study conclusion.

5.2 Life-Cycle Phase-Dependent Activities

Life-cycle, phase-dependent activities are those performed during specific phases of the development life cycle. Life-cycle models exhibit variability with respect to how the phases are labeled, what specific activities are included in a particular phase, and how the phases overlap during transitions. The model presented in Exhibit 5-8 has been tailored to provide insight into the EOSDIS IV&V tasks in general, and the in-line testing activities to be performed for EOSDIS components, interfaces and systems certification in particular. This tailoring is most evident in the

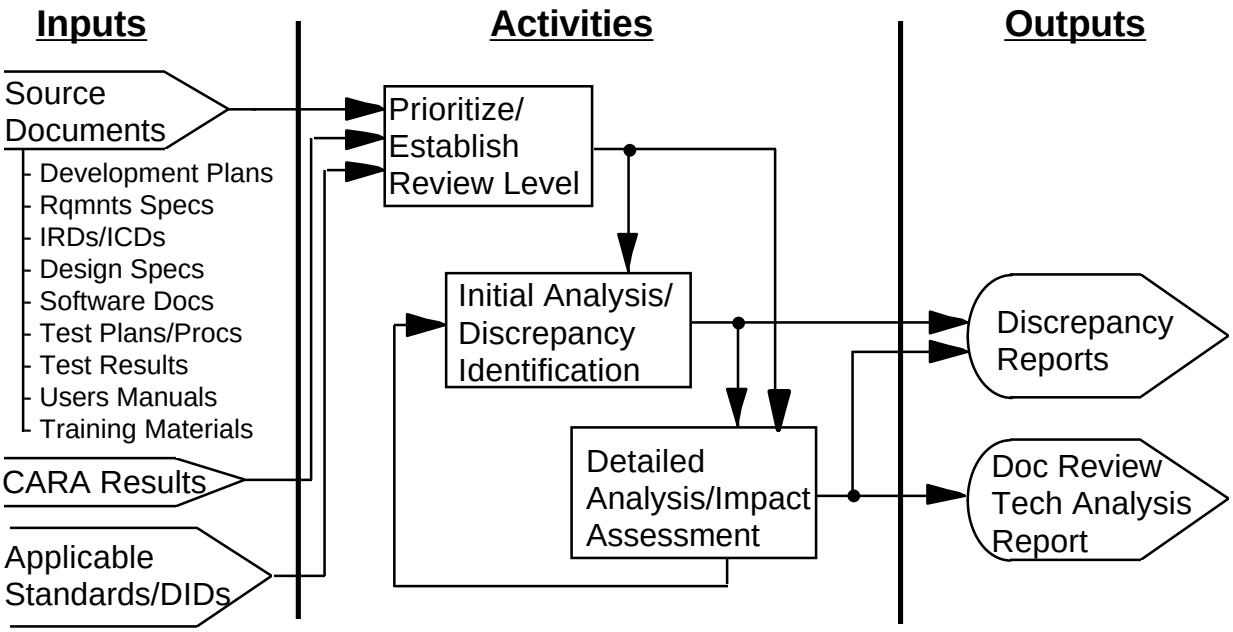

EXHIBIT 5-5. Document Review Activity Network

5.1.6 Formal Review Support

The Intermetrics IV&V Team will participate in formal reviews of developers' efforts including System Requirements Reviews (SRRs), System Design Reviews (SDRs), Preliminary Design Reviews (PDRs), Critical Design Reviews (CDRs), and Test Readiness Reviews (TRRs) as appropriate and necessary. This participation extends to supporting NASA in providing a summary assessment of the quality of the review and in the issuance of RIDs concerning the material presented at the review.

The program review support methodology is diagrammed in Exhibit 5-6. Support actually begins in advance of the formal review, when the IV&V review team is formed and creates its review strategy by assessing available pre-review technical documentation, as well as guidelines and expectations for review conduct. This activity includes establishing review priorities using available engineering analyses including the CARA. Review team members attend review sessions in line with their expertise, and participate both in the NASA review assessment and in a review team meeting to draft RIDs.

5.1.7 Analytic Studies/Impact Analyses

Analytic studies/impact analyses are special studies performed when detailed analytic work, beyond that normally expected as part of other IV&V activities, is required concerning particular aspects of the EOSDIS development. These studies may range from technical background investigations (e.g., theoretical analyses of design algorithms) to prototyping/simulating elements

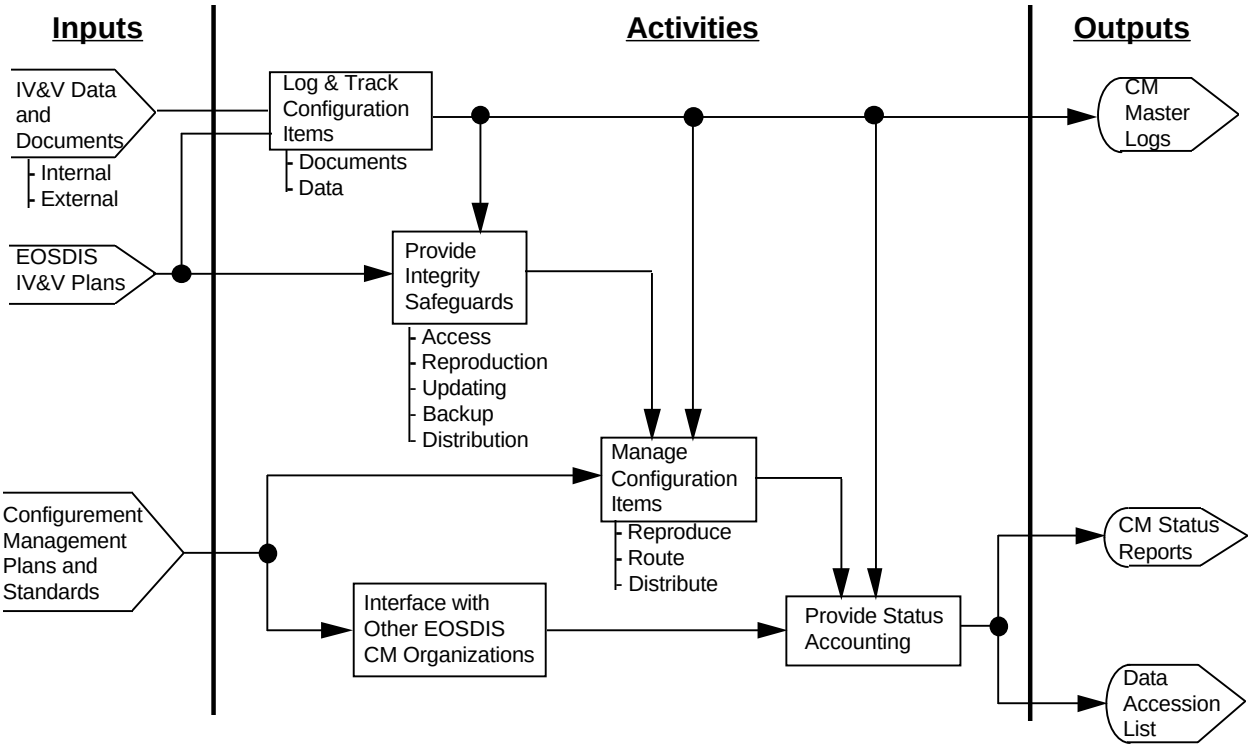

EXHIBIT 5-4. Data and Configuration Control Activity Network

The Intermetrics Team will employ the document review methodology depicted in Exhibit 5-5 for EOSDIS IV&V. As documents are received, they are prioritized for review and analysis. This prioritization serves both to establish the order in which the documents will be assessed and the level (depth) of that assessment. The results of CARA analyses are fundamental to the prioritization which ensures that the document review process is continually aligned with EOSDIS program goals and constraints.

A two-pass review methodology is utilized. On the first pass the reviewer makes margin notes in the document and flags areas that may require further analysis, or that may represent a deficiency serious enough to warrant issuance of a DR. Areas so identified are discussed with the Task Lead and/or FAL for disposition, and to establish the need for possible analytic studies or impact analyses beyond the scope of the document review task (see Section 5.1.7). Analyses within scope of the document review (essentially short pen and paper studies) are completed and the second pass review of the document initiated. On this second pass, the reviewer applies the results of analyses performed, and formulates the review comments to be issued in the document review Technical Analysis Report (TAR).

The entire documentation review process is scaleable to workload, time availability, and dollar limitation constraints, thus ensuring that the document review process does not become an end to itself and consume inordinate amounts of project resources.

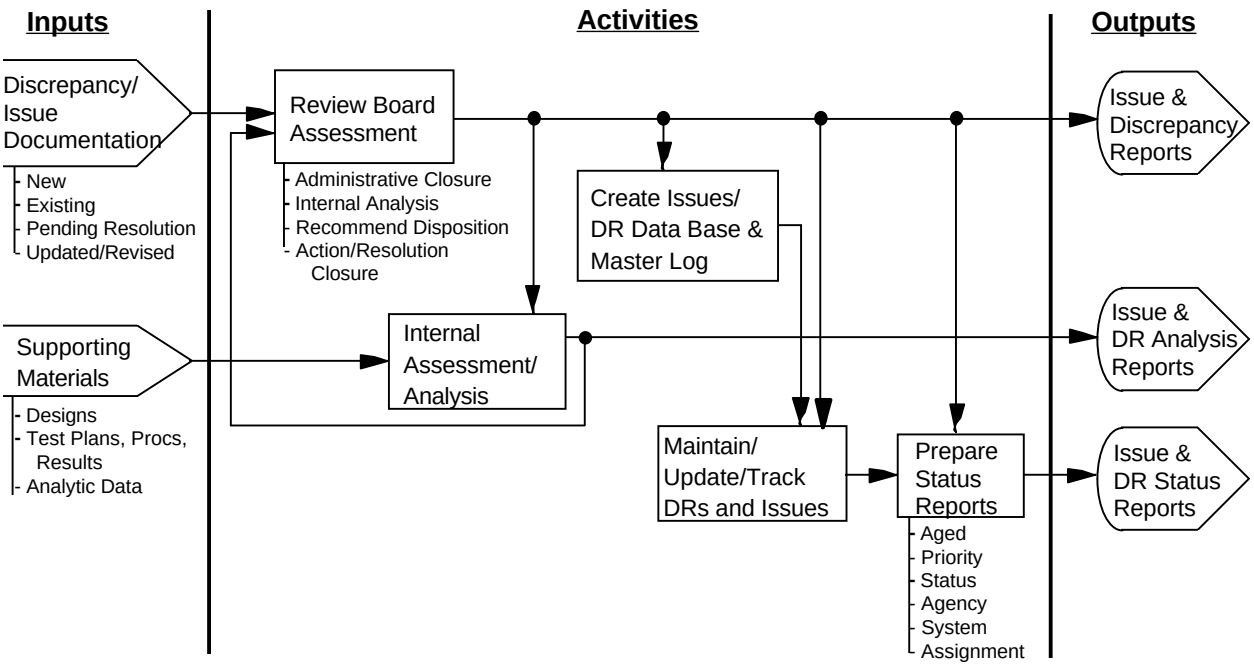

EXHIBIT 5-3. IDHS Activity Network

General procedures for configuration and data control on the EOSDIS IV&V are illustrated in Exhibit 5-4. Major functions include data and configuration item logging and tracking, integrity maintenance, distribution, and status accounting. Interfaces with other EOSDIS Configuration Management (CM) organizations, to include the program office and the developers, will be maintained. This helps ensure the timely exchange of information with these agencies, and facilitates coordination of test configuration, when the IV&V contractor assumes in-line responsibility. This responsibility transition occurs following completion of contractor tests as detailed in Section 5.2. Principal outputs from the configuration and data control system are CM Status Reports and the Data Accession List. The former summarizes the current status of items under formal configuration control, and the latter details items added to the library/inventory during a reporting period.

5.1.5 Documentation Reviews

Document reviews are a mainstay of any IV&V effort. The interim products of a software development effort are documents, and they must be analyzed to ensure the right product is being developed in an efficient manner. Life-cycle verification requires that the outputs of each phase phase be complete, be consistent with the input requirements, and be capable of ready incorporation in the next phase (i.e., be unambiguous). These general criteria are employed when reviewing any document. More specific criteria related to both the life-cycle phase the project is in, and the type of document being reviewed are also employed.

- To prioritize items for work sequencing (e.g., for determining the sequence in which a set of documents will be analyzed),
- To assess overall and relative risks (e.g., determine where to concentrate activities to maximize impact/payoff to the program), and
- To establish importance levels (e.g., determine focal points/issues or establish priorities for where/what to concentrate on while engaged in IV&V analyses).

5.1.3 Issue/Discrepancy Handling

The EOSDIS IV&V contractor will provide the EOSDIS program-level Issue/Discrepancy Handling System (IDHS). The tracking and reporting portion of the IDHS will be automated, and will be capable of maintaining and cross-referencing multiple data bases. The goal is to have a system that is compatible with those being utilized by the development agencies for ECS, EDOS and Ecom. This will facilitate transferring open issues, action items, nonconformance reports, Review Item Discrepancies (RIDs), etc. from developer cognizance to EOSDIS program cognizance following delivery of a release. The IDHS becomes the Issue/Discrepancy repository following official delivery of a release configuration to NASA.

As illustrated in Exhibit 5-3, operation of the IDHS is closely aligned with that of a review and evaluation board in which the actual decision making authority to accept, reject, close and/or dispose issues/discrepancies is vested. It is anticipated that the IV&V contractor will have full-membership representation on this board. The composition and charter of the board is currently TBD.

Based on review board evaluations, issues and Discrepancy Reports (DRs) are entered into the data bases and assigned a tracking number within the master log for the appropriate data base. Cross-linkages to other data bases (and to other tracking systems in the case of inherited reports) are compiled. The status of an issue/discrepancy can only be changed by board action, with the data bases updated accordingly. Status reports summarizing the contents of the data bases are generated at regular intervals (monthly or weekly depending on program schedule and urgency considerations), or on demand. These reports will group and order items with respect to a number of possible characteristics: age, priority, current status, status change, affected system, issuing agency, responsibility assignment, etc.

5.1.4 Configuration and Data Control

The EOSDIS IV&V contractor has responsibility for controlling configuration and data items under his cognizance. This includes: (1) data items generated by the IV&V contractor, (2) data items supplied to the IV&V contractor whose configuration must be maintained, and (3) configuration items supplied to the IV&V contractor for his use during the program. This latter category includes items of test support equipment such as the EOSDIS Test System (ETS). Test tools procured or developed by IV&V are also included.

The general sequence of activities associated with performance of a CARA is given in Exhibit 5-2. Early activities establish the context (purpose and scope) of the particular CARA and, based on this context (which includes identification of the elements to be ranked), select the criticality areas and risk drivers for detailed evaluation. Risk drivers can include such considerations as complexity, maturity of technology base, requirements volatility (stability), testability, experience base, available resource base, suitability of tools/techniques, etc. Criticality areas include operations (mission/user), programmatics (cost/schedule), technical, and safety. When setting up the CARA, each risk driver and criticality area is defined in terms of the rating criteria to be used (i.e., the guidelines for assigning a particular score). These definitions are EOSDIS and CARA context specific and reflect program goals and objectives. Consideration is also given to other inputs, such as program documents. The next step is to have domain experts evaluate the program elements with respect to the rating factors (criticality areas and risk drivers) and record their evaluations in the scoring matrices. Scores are tabulated, a weighted composite is formed for each element being evaluated, and the results are averaged across all domain experts to produce the final CARA score. The program elements are then rank ordered and sequenced according to the score received.

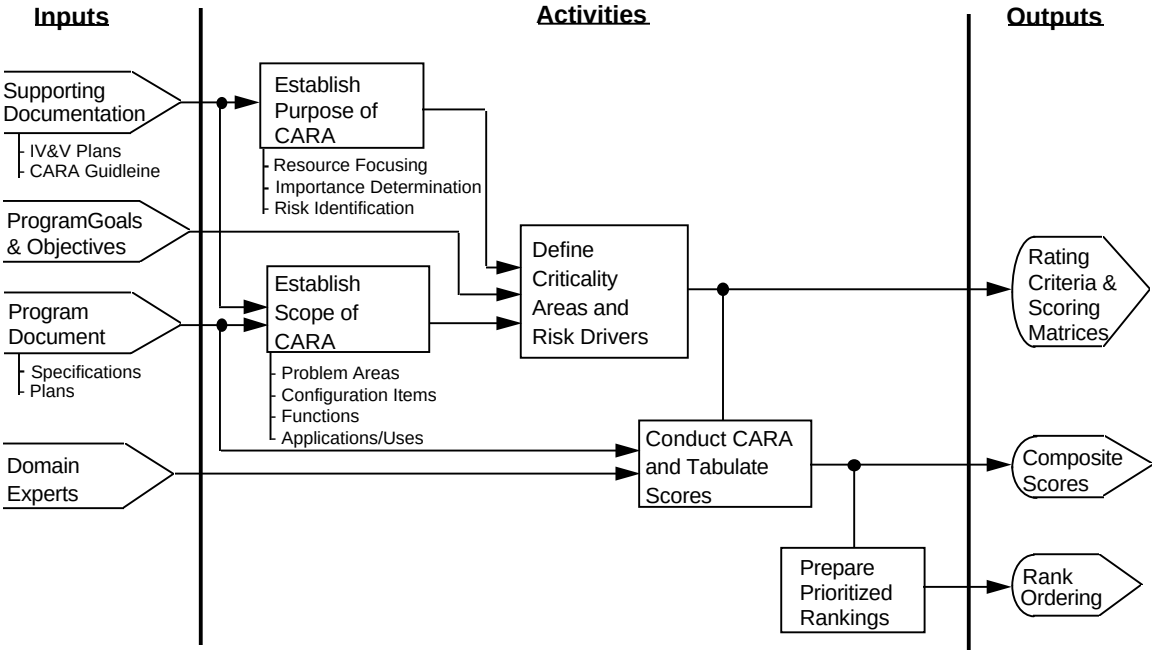

EXHIBIT 5-2. CARA Activity Network

On EOSDIS, a CARA is performed as part of the IRVVP planning process and at other program milestones as needed. The results can be used in a number of ways:

- To allocate a fixed set (given level) of resources across a set of objectives/tasks,
- To assess the need for future resource requirements (i.e., to determine the IV&V resources required for a certain level of coverage),

EXHIBIT 5-1. Traceability Activity Network

5.1.1 Traceability

Traceability is the cornerstone of the Intermetrics IV&V methodology. It commences as soon as the first requirement is known and extends across every phase of the life-cycle. Exhibit 5-1 summarizes the traceability methodology. Initial activities focus on defining the requirements hierarchy and establishing the data base linkages that are to be maintained. As the program progresses through the phases of the life-cycle, each successive detail level is coupled to the level that precedes it.

The importance of the traceability activity lies in the uses to which the resultant traceability data bases can be put. These data bases can be searched, traced, and analyzed to enable:

- Management of cross-release requirements allocation,
- Identification of dangling requirements (i.e., requirements not implemented) and extraneous code (i.e., code not driven by a defined requirement),
- Identification of common-requirement code coupling (a common source of maintenance coding errors),
- Scope/impact of proposed changes to the requirements base (valuable during requirements scrubs prompted by program redefinition/redirection),
- Determination of test program coverage, and
- Assessment of validation and/or regression testing needs.

In theory, the traceability methodology can be applied either manually or automatically; in practice, the number of requirements to be managed on the EOSDIS program can only be effectively tracked via anautomated process. The ECS and Ecom developers are employing the Requirements Traceability Management (RTM) tool from Marconi for this purpose, and the Intermetrics Team will employ the same tool for the IV&V traceability function.

5.1.2 Criticality Analysis and Risk Assessment

The Criticality Analysis and Risk Assessment (CARA) methodology is a systematic procedure for rank ordering EOSDIS program elements with respect to well-defined scoring factors associated with criticality areas and risk drivers of importance to the EOSDIS program. It provides an arithmetical basis for formulating composite orderings of items with respect to multiple, possibly-dissimilar rating factors. The results of a CARA are used to support decision making associated with establishing program directions, determining resource needs, and allocating resources. Because a CARA has an underlying mathematical formalism, it provides a degree of rigor not found in purely subjective decision-making paradigms. The CARA methodology can be applied to a variety of elements over the program life cycle, including potential/actual problem areas, configuration items, functions, and applications/uses of the system.

5. Life-Cycle V&V Activities

EOSDIS IV&V mixes traditional life-cycle support V&V tasks with tasks that are in-line to the development effort. In particular, the role assigned to the EOSDIS IV&V contractor during the testing phase entails a progression of certification activities beginning with the EOSDIS ECS and EDOS components, encompassing key interface and integration, and culminating with end-to-end system certification. Because certification is conducted with respect to the functional and performance requirements, it may be conveniently labeled validation, and the IV&V activities that precede it in the life cycle may be thought of as verification. Such a grouping is consistent with the traditional definitions of verification and validation (see glossary in Section 3).

The methodologies that the Intermetrics Team will employ to accomplish the EOSDIS IV&V objectives can be categorized as life-cycle phase independent or life-cycle phase dependent. Life-cycle phase independent activities are those that can either be applied in substantially the same form in more than one phase of the development life cycle, or those that, because of their intrinsic definition, span multiple (one or more) phases of the life cycle. For example, a Criticality Analysis Risk Assessment (CARA) activity can be conducted during any phase of the life cycle, while a prototyping activity could span multiple phases. Life-cycle phase-dependent activities are those that can be aligned with milestones associated with specific life-cycle phases. Source code analysis offers a good example of this type of activity.

The following sections describe Intermetrics' approach to EOSDIS IV&V, proceeding from the general to the particular. Life-cycle phase independent and dependent activities are summarized in Sections 5.1 and 5.2, respectively. The manner of presentation is based on activity networks and the goal is to provide a broad perspective of the methodology that will be employed for each activity. This overview identifies task-level activities that are accomplished (i.e., "what" tasks will be performed). Specific details associated with performing IV&V individual task activities (i.e., "how" tasks will be performed) are given in the lower level V&V plans (the ISVVP or the IRVVP) and in the EOSDIS Integration and Certification Plan (EICP).

After the general discussion of methodologies, a framework for the specific tasks associated with the EOSDIS IV&V is developed in Section 5.3. A paradigm for categorization and organization of the initial set of tasks is provided, and applicable life-cycle activities are identified for accomplishment of these tasks. An early-year schedule is provided for the first eleven EOSDIS IV&V technical tasks.

5.1 Life-Cycle Phase-Independent Activities

Life-cycle, phase-independent IV&V activities are those whose methodology and approach descriptions either can be given without a contextual background associated with a specific phase of the life cycle, or span multiple phases of the life cycle. Task-level details for applying these methodologies are deferred to lower level plans.

4.5 Tools, Techniques and Methodologies

Exhibit 4-8 provides a roadmap to the IV&V tools, techniques and methodologies that will be employed on EOSDIS. The exhibit is done in activity network format with inputs identified on the left, activities in the center, and outputs on the right. The general flow is from left to right and top to bottom. Activity networks primarily illustrate the logical progression of activities, and only provide a rough indication of time sequencing. They are not sufficient to enable scheduling analysis.

The Intermetrics Team's basic approach applies proven techniques for planning, task management and tool management to well-defined methodologies for conduct of specific life-cycle phase-independent and phase-dependent IV&V tasks. These tasks are focused on products of the EOSDIS developers and time scheduled in accordance with task order Statements of Work (SOWs) received from NASA. In addition to deliverables associated with particular tasks, planning documents, analytic studies, technical reports and traceability between life-cycle phase outputs are provided. Additional details for each level of IV&V activity may be found in the sections of this plan referenced in the exhibit: technical activities are described in Section 5, reporting requirements are summarized in Section 6, and management related activities are in Section 7. Also included in Section 7.3 is a categorized list of potential EOSDIS IV&V automated tools.

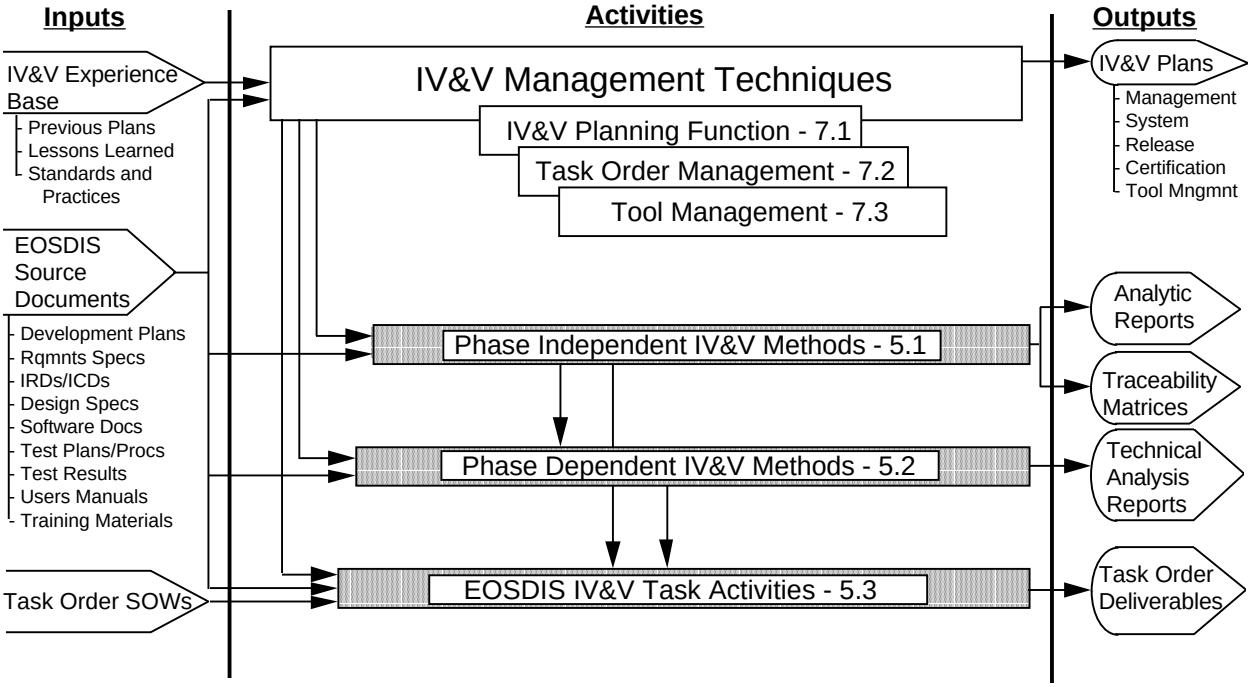

EXHIBIT 4-8. IV&V Tools, Techniques and Methodologies for EOSDIS

hardware-intensive test tools such as remote terminal emulators, the EOSDIS Test System (ETS) and the Spacecraft Simulation (SSIM) will not be integrated into the ISE framework.

Further information can be found in the ISE System Requirements document, the EOSDIS Integration and Certification Plan, and the Tool Management Appendix to this IVVMP.

4.4 Roles and Responsibilities

Roles and responsibilities for the functional elements in Exhibit 4-2 are defined in this section.

The IV&V Program Management function is responsible for establishing operational policy and overall direction for conduct of the EOSDIS IV&V. The Program Manager (PM) is the primary interface with NASA ESDIS project management, with the management staffs at the ECS and EDOS developers, and with the corporate staffs of the IV&V team members. He has full authority over all resources assigned to the project and is responsible for the task level allocation of these resources. Tasks are received, accepted and assigned to Task Leaders by the PM. He is also responsible for fiscal performance on the contract and for the reporting of technical, schedule and cost performance.

The Program Planning and Control function is responsible for establishing, maintaining and reporting the task order budgets. Task order cost profiles are prepared by this office. Program Planning and Control interfaces with the NASA contracts office and is responsible for the timely and accurate reporting of task order budgets in monthly and quarterly financial reports. It also interfaces with NASA to ensure full coordination of all equipment purchases.

Business Operations has responsibility for the facilities, tools, networks and other elements of the IV&V physical infrastructure. This includes requisitioning, purchasing and contracting for maintenance of all elements of this infrastructure. Business Operations acts as the administrative deputy for the Program Manager and is responsible for reporting the status of the IV&V effort on a monthly basis. This function establishes office procedures to ensure orderly and timely information flow to all team members. Responsibilities extend to creating the internal library system and serving as the training coordinator for the EOSDIS IV&V.

Functional Area Leads are responsible for representing the EOSDIS IV&V project to external organizations within their assigned area of technical expertise. They establish overall technical directions and approaches for their areas, and ensure consistency across task orders and organizational interfaces.

Task Leads are responsible for establishing the technical objectives, directions and approaches for individual tasks, for preparing staffing profiles for these tasks, for managing the day-to-day conduct of the tasks, for reporting task level progress and accomplishments, and for generating required technical reports and supporting documents. Task Leads have the authority to direct resources assigned to their task in the accomplishment of task objectives. Task Leads are responsible for maintaining the flow of technical information across organizational interfaces.

4.3 Resource Summary

4.3.1 Facilities

The EOSDIS IV&V is based at facilities located on Ivy Lane in Greenbelt, Maryland, near GSFC, and at the WVU/NASA IV&V Center on University Drive in Fairmont, West Virginia. IV&V project staff from the subcontractors are collocated with Intermetrics. Operations are fully integrated and resources are shared equally. Modern telecommunications services including e-mail, Internet access, and fax are provided.

4.3.2 Personnel

The ten-year staffing plan for the EOSDIS IV&V is given in Exhibit 4-7. Entries are in person-years of delivered labor allocated to labor categories and contract years. A contract year is defined as the period from 16 June of the year identified to 15 June of the following year. The labor categories are as defined in the contract. All require a minimum of 3 years relevant experience, and all positions, save the schedule specialist and clerical, require a college/university degree. Yearly totals across labor categories are presented in the bottom row, while the ten-year totals for each labor category are in the last column.

LABOR CATEGORY	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	TOTAL
Program Manager	2.5	1.5	2.0	2.0	2.0	3.0	2.0	1.5	1.5	1.5	19.5
Software Sys Specialist	2.5	5.5	6.5	7.0	5.5	3.5	3.0	2.5	2.5	2.5	41.0
Senior Systems Engineer	18.0	27.0	29.0	30.5	32.0	27.5	27.5	21.0	21.0	21.0	254.5
Systems Engineer	14.0	14.5	17.0	18.0	18.0	18.0	17.0	13.0	13.0	13.0	155.5
Data Base Specialist	1.5	2.0	3.0	3.0	3.0	5.0	5.0	3.5	3.5	3.5	33.0
MIS Programmer	1.5	0.5	1.0	2.0	3.0	5.0	5.0	3.5	3.5	3.5	28.5
Clerical	2.0	1.0	2.5	3.0	3.0	5.5	4.5	4.0	4.0	4.0	33.5
Scheduler	1.0	1.0	1.0	1.5	1.5	2.5	1.0	1.0	1.0	1.0	12.5
TOTAL	43.0	53.0	62.0	67.0	68.0	70.0	65.0	50.0	50.0	50.0	578.0

EXHIBIT 4-7. EOSDIS IV&V Staffing Profile

4.3.3 Equipment

The EOSDIS IV&V is supported by a centralized resource for managing, archiving, and maintaining IV&V-related data products and reports. All such materials are held in an Integrated Information Repository (IIR) that is part of the Integrated Support Environment (ISE), located at the Fairmont, West Virginia, facility. When completed, the ISE will provide electronic storage and access for all reports and data bases generated by EOSDIS IV&V.

IV&V tools used to support analyses of developer products will be integrated into the ISE infrastructure. This includes tools that support the test planning, executing and reporting process. Certain test tools, such as software drivers and data sets, will be resident within the ISE. Other

EXHIBIT 4-6. Conceptual Progression of IV&V Activities

EXHIBIT 4-5. EOSDIS Master Schedule

AGENCY/FUNCTION	POINT OF CONTACT	POINT OF CONTACT	Focus Team / WG
1. ESDIS (Code 505)	J. Gitelman	F. Rockwell	
- M & O	A. Kelly	J. Smith	MOFT
- Networks/ Comm.	R. desJardins	T. Truitt	SOFT
- DAAC & Operations	G. Hunolt	F. Rockwell	SOFT
- Science S/W	T. Meyer	F. Rockwell	DPFT
- SDPS (architecture)	M. Szczur	D. Izumi	DOAFT
- SDPS (processing)	S. Kempler	D. Izumi	DPFT
- Version 0	D. Blake	P. VanWie	SOFT
2. Science Users/DAACs	Rotating Chairperson	A. Sanyal	USWG
- ADCs / ODCs	M. Schwaller	A. Sanyal	SOFT/USWG
- Instrument Teams (PI/TL/TM)	S. Wharton (902)	A. Sanyal	USWG
3. EDOS	Jamison / Benjamin (560)	S. Cherng	(TRW)
- I & T	P. Myers (560)	S. Cherng	
- Data & Operation	G. Knoble (560)	S. Cherng	
4. Ecom	Jamison / S. Smith (540)	P. Doan	
5. NASA Institutional Support (Code O)	G. Smith	T. Truitt	
6. Other MTPE Flight Projects			
- TRMM	T. Ackerson	R. Weiss	(WG)
- Landsat-7	J. Smith	R. Weiss	DOAFT
7. ECS Project			
- NASA		P. Van Wie	
--FOS	A. Johns (510)	J. Smith / K. Murphy	MOFT
--SDPS	M. Szczur	D. Izumi/ T. Wolfrom	SOFT
--CSMS	R. desJardins	T. Truitt	SOFT
- HAIS	G. Scott	various	
8. ETS Project	W. Fuller (513)		ETS / WG
- Requirements / Development	C. Rauta	P. VanWie	(CSC)
9. EOS Flight Project	A. Kelly (Code 505)	J. Smith	MOFT
10. Focus Teams (FT)			
- Mission & Operation MOFT	A. Kelly / A. Johns	J. Smith	MOFT
- Science Operations SOFT			
--Operation sub-panel	G. Hunolt / T. Meyer	T. Wolfrom	SOFT (operation)
--Science sub-panel	S. Wharton	A. Sanyal	SOFT (science)
- Data Processing DPFT	T. Meyer / S. Kempler	D. Izumi	DPFT
- Data Organization & Access			
--DOAFT	M. Szczur	D. Izumi	DOAFT
11. Working Groups (WG)			
- System Implementation Team	G. Smith	J. Smith/ S. Imoff	
- User Services			
--USWG	S. Wharton	A. Sanyal	SOFT
- EOS Test System			
--ETS/WG	J. Gitelman	P. VanWie	
12. Key Interfaces			ICWG
-Version 0	G. Hunolt	T.Wolfrom	
-SCFs	Scott/T. Meyer	T.Wolfrom	
-NSI	R. desJardins	R. Weiss	
-Landsat-7	T. Ackerson	K. Murphy	
-MITI (ASTER)	M. Schwaller	K. Murphy	
-TRMM	T. Ackerson	K. Murphy	
-EDOS	D. Jamison	V. Venkatesh	
-AM-1 Flight Project	A. Kelly	S. Imhoff	
-NOAA (R/T Data)	D. Jamison	T. Wolfrom	
-ADCs	G. Hunolt	T. Wolfrom	
-IPs	M. Schwaller	S. Imhoff	
-NASA Institutional	G. Smith	S. Imhoff	
-Aerosol Spacecraft	A. Kelly	S. Imhoff	
-PSCN	R. desJardin	R. Weiss	
-PM Spacecraft	A. Kelly	S. Imhoff	
-Chemistry Spacecraft	A. Kelly	S. Imhoff	
-AM-2 Spacecraft	A. Kelly	S. Imhoff	
-COLOR Spacecraft	A. Kelly	S. Imhoff	

EXHIBIT 4-4. Organizational Interface Points of Contact

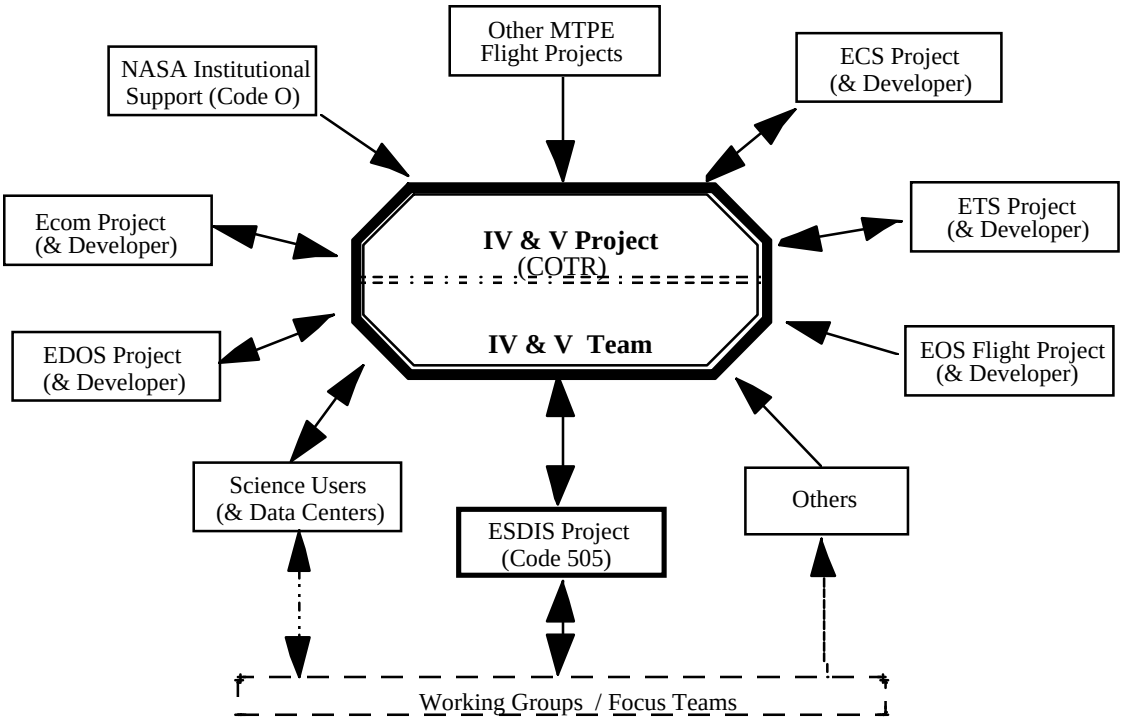

EXHIBIT 4-3. Organizational Interfaces Supported by the IV&V Team

Exhibit 4-4 identifies candidate points of contact on either side of the interfaces identified in Exhibit 4-3. Contact has been established with HAIS and agreement on open information exchanges with direct contact at the engineering level has been reached.

4.2 Master Schedule

The EOSDIS IV&V contract has a ten-year period of performance commencing 16 June 1994. Exhibit 4-5 provides the master schedule for EOSDIS development, integration and certification through the issuance of ECS Release C at the conclusion of 1999. The IV&V effort appears as three lines on this schedule. Reading from the bottom of the exhibit, the first IV&V line illustrates the on-going and undifferentiated process of life-cycle verification activities, the second IV&V line delineates IV&V certification testing of ECS releases, and the third IV&V line is that associated with Key Interface Testing (KIT) which commences with the TRMM interfaces.

The progression between these three IV&V activities (life-cycle verification, certification testing, and KIT) is illustrated for an arbitrary release in Exhibit 4-6. The presentation in the exhibit is conceptual and does not accurately portray time duration or phasing.

A task-level schedule for the initial set of IV&V tasks is provided in Section 5.3

COMPONENT/	FUNCTION	IV & V TEAM	ASSOCIATED

These functions operate independent of specific task orders and provide day-to-day continuity and direction for the project. The Functional Area Leads (FALs) provide identifiable and recognizable focal points for specific areas chosen because of their importance to the success of EOSDIS and the IV&V effort. Task leads are assigned as tasks are opened, and are responsible for the planning, technical direction, management and reporting associated with individual tasks.

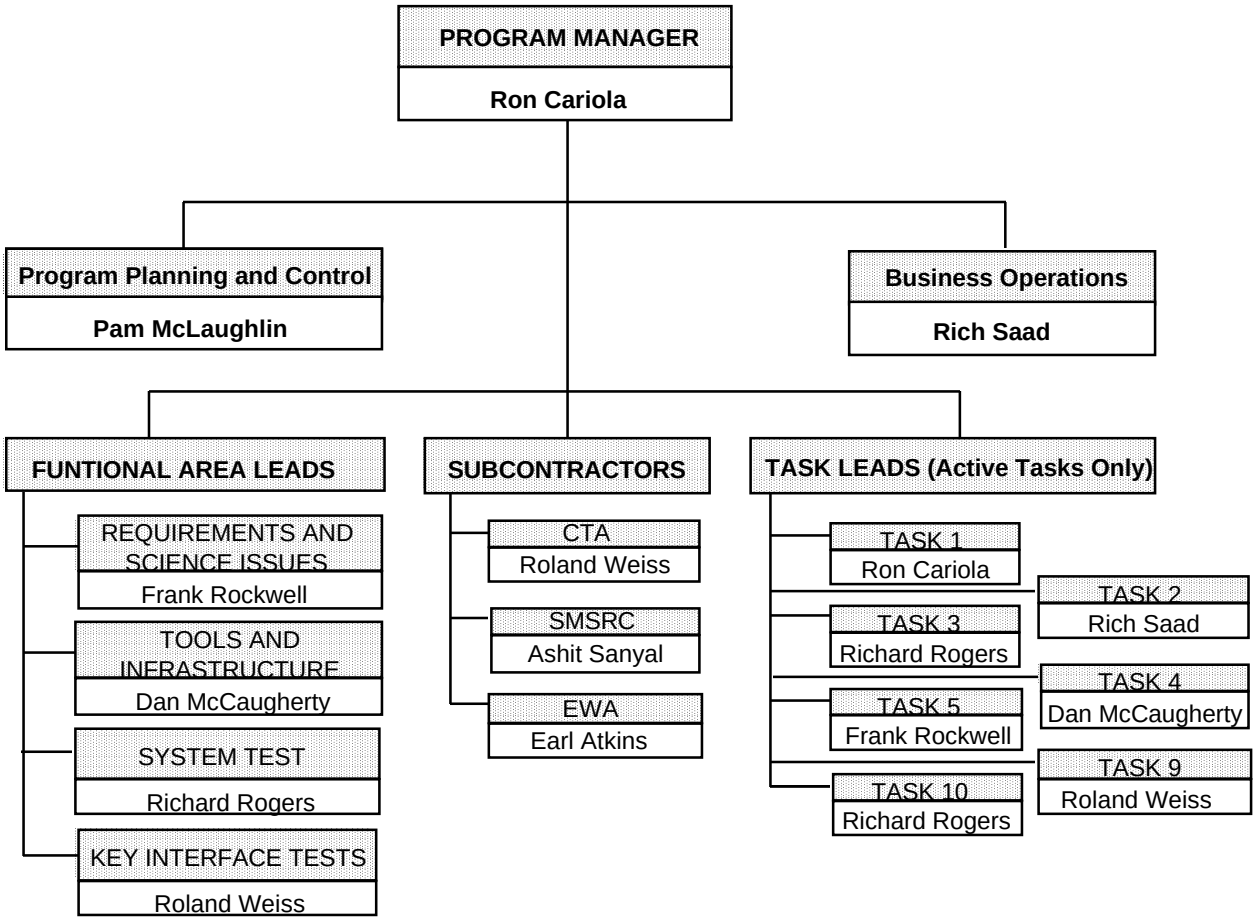

EXHIBIT 4-2. EOSDIS IV&V Organization

In conduct of the EOSDIS IV&V, many external organizational interfaces need to be established and maintained. These interfaces provide conduits into requirements, schedules and technology bases for EOSDIS elements, components and systems. Exhibit 4-3 identifies the organizational entities for which interfaces will be required. The intent is to identify specific points of contact on either side of the interface (i.e., in both organizational entities) and to have these points of contact establish a charter for the timely exchange of information. The general philosophy is direct contact at the working level (i.e., point of contact and below), with as-needed coordination at the management level (point of contact and above). Such an agreement has been reached with HAIS concerning ECS.

4. IV&V Environment

4.1 IV&V Organization and Interfaces

IV&V of EOSDIS will be conducted by a team of technical professionals under the leadership of Intermetrics Systems Services (ISyS) Corporation, the prime contractor. Subcontractor members of the IV&V Team include CTA Incorporated, SM Systems and Research Corporation (SMSRC), and Electronic Warfare Associates (EWA). The team is fully integrated and collocated at facilities in Greenbelt, Maryland and Fairmont, West Virginia. Exhibit 4-1 identifies the senior EOSDIS IV&V representative for each team member and principal areas of responsibility. These assignments are fully consistent with established expertise held by the team members and reflect the basic decomposition of the EOSDIS IV&V effort into activities associated with:

- Project infrastructure (management, organizational interfaces, planning, and tools),
- Functional and performance requirements (systems and interfaces),
- Life-cycle verification (concept through implementation phases), and
- Certification (i.e., validation) of components, interfaces and systems.

TEAM MEMBER	SENIOR REPRESENTATIVE	AREAS OF EXPERTISE
ISyS	Mr. Ron Cariola	• Overall Project Management • Planning • Organizational Interfaces • Life-Cycle Verification • System Requirements • Component Certification • System Certification • Science Systems Integrity • V&V Tools
CTA	Dr. Roland Weiss	• Organizational Interfaces • Life-Cycle Verification • Interface Requirements • Key Interface Certification
SMSRC	Dr. Ashit Sanyal	• Science Requirements • Science User Community Interfaces
EWA	Mr. Earl Atkins	• Life-Cycle Verification

EXHIBIT 4-1. IV&V Team Composition

Intermetrics has structured its EOSDIS IV&V organization with the objectives of providing stable and consistent direction at the project level, establishing focal points for major technical areas within EOSDIS, and maintaining direct accountability/responsibility at the task level. The EOSDIS IV&V organization is depicted in Exhibit 4-2. At the top levels of the organizational hierarchy are the project management, planning and control, and business operations functions.

US	United States
V&V	Verification and Validation
WG	Working Group
WVU	West Virginia University

ISE	Integrated Support Environment
IRVVP	Independent Release V&V Plan
ISVVP	Independent System V&V Plan
ISyS	Intermetrics Systems Services
IV&V	Independent Verification and Validation
IVVMP	IV&V Management Plan
KIIT	Key Interface and Integration Testing
KIT	Key Interface Testing
MOC	Mission Operations Capable
MOFT	Mission Operations Focus Team
MTPE	Mission to Planet Earth
NASA	National Aeronautics and Space Administration
NCR	Nonconformance Report
PDR	Preliminary Design Review
PSR	Program Status Report
RID	Review Item Discrepancy
RTM	Requirements Traceability Management
SCF	Scientific Computing Facility
SDF	Software Development Folder
SDP	Software Development Plan
SDPS	Science Data Processing Segment
SDR	System Design Review
SEAS	System Engineering and Analytical Support
SOFT	Science Operations Focus Team
SOW	Statement of Work
SRR	System Requirements Review
SSIM	Spacecraft Simulation
TA	Task Assignment
TAR	Technical Analysis Report
TBD	To Be Determined
TDRSS	Tracking and Data Relay Satellite System
TO	Task Originator
TRMM	Tropical Rainfall Measuring Mission (U.S.-Japan)
TRR	Test Readiness Review

3.2 Acronyms/Abbreviations

ADC	Affiliated Data Center
CARA	Criticality Analysis and Risk Assessment
CDR	Critical Design Review
CIP	Continuous Improvement Program
CO	Contracting Officer
COTR	Contracting Officer Technical Representative
COTS	Commercial Off The Shelf
CSMS	Communications and Systems Management Segment
CTR	Contractor Task Report
DAAC	Distributed Active Archive Center
DoD	Department of Defense
DOFT	Data Operations Focus Team
DPFT	Data Processing Focus Team
DR	Discrepancy Report
Ecom	EOS Communications System
ECS	EOSDIS Core System
EDOS	EOS Data and Operations System
EICP	EOSDIS Integration and Certification Plan
EOC	EOS Operating Center
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
ETS	EOSDIS Test System
F&PR	Functional and Performance Requirement
FAL	Functional Area Lead
FOS	Flight Operations Segment
GOTS	Government Off The Shelf
GSFC	Goddard Space Flight Center
GSIWG	Ground System Integration Working Group
HAIS	Hughes Applied Information Systems
I&T	Integration and Test
IATO	Independent Acceptance Test Organization
IDHS	Issue/Discrepancy Handling System
IEEE	Institute of Electrical and Electronic Engineers
IIR	Integrated Information Repository
IR1	Interim Release 1

MODELING. An investigative technique that uses a mathematical or physical representation of a system or theory that accounts for all or some of its known properties. Models are often used to test the effects of changes of system components on the overall performance of the system.

OPERATIONS. Within EOSDIS, those activities directly related to the acquisition, archiving, distribution, and processing of mission-related information.

RETURN LINK DATA. Spacecraft health and status data and instrument data.

VERIFICATION. The process of determining whether or not the products of a given phase of the software development cycle fulfill the requirements established during the previous phase.

VALIDATION. The process of evaluating software at the end of the software development process to ensure compliance with software requirements.

3. Definitions

3.1 Glossary

ACCEPTANCE TESTING. Formal testing conducted to determine whether or not a system satisfies its acceptance criteria, and to enable the customer to determine whether or not to accept the system.

ALGORITHM. A step-by-step mathematical procedure for solving a problem. Each step is precisely and unambiguously defined so that in principle it can be carried out by machine.

ARCHIVED HOLDINGS. All EOS and non-EOS data and data products, as well as supporting information, that are archived by EOSDIS. This includes models, algorithms, documentation, and Level 0 data or higher level data products.

CERTIFICATION. The process of affirming the level of performance delivered by the system with respect to precisely defined criteria directly related to the Level 2 and 3 requirements.

DATA SET. A logically meaningful grouping or collection of similar or related data.

DISTRIBUTED ACTIVE ARCHIVE CENTER. An EOSDIS facility that generates, archives, and distributes EOS Standard Data Products, and related information, for the duration of the EOS mission. An EOSDIS DAAC is managed by an institution such as a NASA field center or a university, under terms of an agreement with NASA. Each DAAC contains functional elements for processing data, for archiving and disseminating data, and for user services and information management.

EOS DATA AND INFORMATION SYSTEM (EOSDIS). A facility that will manage the data resulting from NASA's Earth science satellites and field measurement programs, and other data essential for the interpretation of these measurements. It will also provide access to data held in the archives of other government agencies, organizations, and countries. EOSDIS will generate standard data products, and will facilitate the combination and manipulation of data from all sources as well as their incorporation into models of the environment.

FORWARD LINK DATA. Instrument control and spacecraft control data.

INDEPENDENT VERIFICATION AND VALIDATION (IV&V). A process whereby the products of development life cycle phases are independently reviewed, verified and validated by an organization that is neither the developer nor the acquirer of the software. IV&V differs from Verification and Validation (V&V) only in that it is performed by an independent organization.

INTEGRATION. The process of combining one or more elements and, through testing, confirming that the elements correctly perform allocated functions and support higher level requirements.

IEEE Std. 1028-1988 Standard for Software Reviews and Audits

IEEE Std 1042-1987 Guide to Software Configuration Management

IEEE Std 1044-1993 Standard for Classification of Software Anomalies

IEEE Std 1045-1992 Standard for Software Productivity Metrics

IEEE Std 1058-1-1987 Standard for Software Project Management Plans

IEEE Std 1059-1993 Guide for Software Verification and Validation Plans

IEEE Std 1061-1992 Standard for a Software Quality Metrics Methodology

IEEE Std 1063-1987 Standard for Software User Documentation

IEEE Std 1074-1991 Standard for Developing Software Life Cycle Processes

IEEE Std 1209-1992 Recommended Practice for the Evaluation and Selection of CASE Tools

IEEE Std 1219-1992 Standard for Software Maintenance

IEEE Std 1298-1992 Standard for Software Quality Management System, Part 1: Requirements

Intermetrics Documents

Deliverable 0405 ISE System Requirements 28 October 1994

Deliverable 1001 White Paper: Independent Verification and Validation Approach to the EOSDIS Certification Program, Levels, Methods, Criteria and Tools 17 October 1994

2. Reference Documents

The following documents are either referenced or used as source material by this EOSDIS IV&V plan.

NASA/Military Standards

DOD-STD-2167A Defense System Software Development

DOD-STD-2168 Defense System Software Quality Program

MIL-STD-882B System Safety Program Requirement

Other NASA/Military Documents

NHB 9501.2B Procedures for Contractor Reporting of Correlated Cost and Performance Data

SOW for EOSDIS IV&V, NASA Contract No. NAS5-32605, 1994

Other Documents

IEEE Std 730-1989 Standard for Software Quality Assurance Plans

IEEE Std 828-1990 Standard for Software Configuration Management Plans

IEEE Std 829-1983 Standard for Software Test Documentation

IEEE Std 830-1993 Guide to Software Requirements Specification

IEEE Std 982.1-1988 Standard Dictionary of Measures to Produce Reliable Software

IEEE Std 928.2-1988 Guide for the Use of IEEE Standard Dictionary of Measures to Produce Reliable Software

IEEE Std 1002-1987 Standard Taxonomy for Software Engineering Standards

IEEE Std 1008-1987 Standard for Software Unit Testing

IEEE Std 1012-1986 Standard for Software Verification and Validation Plans

IEEE Std 1016-1987 Recommended Practice for Software Design Descriptions

IEEE Std 1016.1-1993 Guide to Software Design Descriptions

done under the supposition that the EDOS and Ecom development efforts will be of smaller scale and complexity, and consequently will be amenable to the same techniques and methodologies defined for IV&V of the ECS.

life-cycle V&V activities. In addition, because of the large volumes of data in the system, the technical complexities of the interface mechanization, and their criticality for system operations, NASA has identified a set of key interfaces for which IV&V analysis and testing will be conducted. IV&V responsibilities extend to testing of ECS functionality in the DAACs and SCFs. This includes science software functionality and operability (but not correctness).

This IV&V Management Plan (IVVMP) provides descriptions of methodologies, techniques, and tools that Intermetrics Systems Services (ISyS) Corporation will employ as the EOSDIS IV&V prime contractor. This IVVMP also describes the management approach, organization and resources that will be applied. This plan is one of a sequence of plans that will be prepared and delivered to NASA. Exhibit 1-1 provides an overview of the coupling between these plans.

This IVVMP addresses the EOSDIS IV&V in the large, describing what will be done and what level of resources will be applied in total. The Independent System V&V Plan (ISVVP) addresses the development life-cycle in detail and explains how the IV&V methods, tools and techniques can be applied to EOSDIS. The EOSDIS Integration and Certification Plan (EICP) further elaborates the testing portion of the IV&V effort. EOSDIS IV&V testing is a mainstream activity, performed in-line with the development effort, that encompasses test and integration of all principal components, and certification of the end-to-end operation of the resultant system. Finally, an Independent Release V&V Plan (IRVVP) provides specifics concerning the efforts that will be performed for a particular release of an EOSDIS component (e.g., ECS Release A).

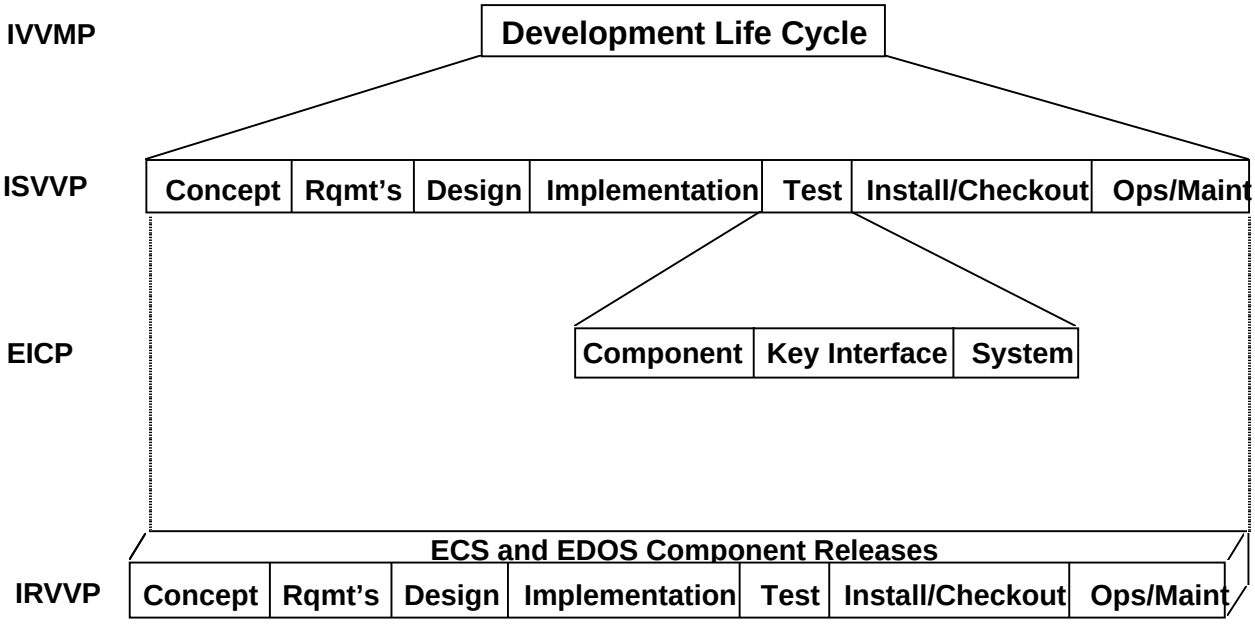

EXHIBIT 1-1. Logical Relationship Between Planning Documents

Because the ECS development model is well-defined, presents significant challenges for management of IV&V, and represents a major portion of the overall EOSDIS, this IVVMP concentrates on matters relating to ECS and the HAIS multi-track development model. This is

DAACs are the responsibility of their sponsoring agency. They will, if practical, utilize common hardware and software subsystems, and derive much of their functionality from the ECS. ECS is being developed by Hughes Applied Information Systems (HAIS) as a series of incremental releases, commencing with Interim Release 1 (IR1) and continuing with Releases A, B, C, and D over a ten year period. IR1 and Releases A and B are being developed in parallel, while Releases C and D are strictly time-sequential. The SCFs will be developed by science investigators using toolkits provided by the ECS contractor. External networks are non-developmental items. Award of the EDOS development to TRW has been announced, and an incremental development effort is anticipated. Ecom is being developed by NASA GSFC Code 540 utilizing in-house and support-contractor resources.

1.2 Purpose

The EOSDIS IV&V is directed toward assessing system integrity, ensuring proper implementation of system functionality, and ensuring the operational readiness of the system with the following objectives:

- Detect and correct errors as early as possible in the EOSDIS life cycle,
- Lessen development risks, cost and adverse schedule impacts due to these errors,
- Enhance EOSDIS quality and integrity, and

Increase visibility into and understanding of the EOSDIS development and evolution process.

1.3 Scope

The EOSDIS IV&V effort is focused on the ECS, EDOS and Ecom system components, including those ECS elements at the DAACs and the SCFs. ECS is the pacing component for EOSDIS IV&V, having completed a System Requirements Review (SRR) at which significant focusing took place, and a System Design Review (SDR). ECS is also the largest component with particular releases containing a million or more lines of source code. HAIS is employing a multi-track development effort that supports evolutionary development of the ECS across multiple releases by defining parallel development methodologies for different parts of the system: Formal Development for those ECS elements with stable requirements and well-defined capabilities, and Incremental Development for the more volatile elements of the ECS that evolve to meet emerging needs and capabilities. Prototypes and studies are used to fine-tune/adjust both development tracks. Formal Development elements undergo a standard test progression based on successively higher levels of integration. Incremental Development elements are tested against evaluation packages that serve to exhibit current capabilities and areas for improvement in the next iteration. Both development tracks culminate in Integration and Test (I&T) at the build level and acceptance testing of the release by an Independent Acceptance Test Organization (IATO) hired by, and reporting to, the developer.

The EOSDIS IV&V contractor reports to NASA and is tasked to provide full life-cycle IV&V for both ECS and EDOS. Ecom is tested in concert with ECS and EDOS, but is not subject to other

1. Purpose and Scope

1.1 Introduction

The Earth Observing System (EOS) is an essential part of the Mission to Planet Earth (MTPE) undertaken by the National Aeronautics and Space Administration (NASA) with Goddard Space Flight Center (GSFC) as the lead center. Mission objectives are to:

- Develop a comprehensive data and information system serving scientists' needs for interdisciplinary and multi-disciplinary planet earth studies.
- Provide a global data base of remotely-sensed measurements sufficient to enable systematic investigations of ecological dynamics over time.
- Support the development of a comprehensive understanding of the way the Earth functions as a global system to include atmosphere, ocean, cryosphere, and biosphere interactions.

The EOS Ground System provides support for instrument and satellite command and control, for data collection and archiving, for defining and generating science products, and for distribution of data and products across world-wide information networks. The EOS Data and Information System (EOSDIS) is the centerpiece of EOS Ground System operations. EOSDIS provides the means to enable (1) reliable and timely availability of usable and understandable data, and (2) easy and quick data access and transfer independent of geographic location of the user. Because of the criticality to mission success, NASA has contracted for Independent Verification and Validation (IV&V) of the EOSDIS and key ground system interfaces.

The principal EOSDIS components are:

- Distributed Active Archive Centers (DAACs) - nine data centers each focused on a science discipline that provide science data organization, user access and support services.
- The EOSDIS Core System (ECS) - comprised of the EOS Operations Center (EOC) and the core functions for science data processing to include data archiving and distribution, information management, and product generation. ECS is partitioned into the Science Data Processing Segment (SDPS), the Flight Operations Segment (FOS), and the Communications and Systems Management Segment (CSMS).
- Science Computing Facilities (SCFs) - on the order of 60 facilities enabling science investigators to develop algorithms and maintain quality control over their data products.
- External Networks - used to distribute the data to a wide and diverse user community.
- EOS Data and Operations System (EDOS) - provides telemetry data ingest and standard Level 0 data set production capabilities.

EOS Communications System (Ecom) - provides data transport between ECS and EDOS, intra-ECS, and between EDOS and other NASA institutional elements.

LIST OF EXHIBITS

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EOSDIS
INDEPENDENT VERIFICATION AND VALIDATION (IV&V) MANAGEMENT PLAN

(Deliverable 0301)

December 2, 1994

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EOSDIS
INDEPENDENT VERIFICATION AND VALIDATION (IV&V) MANAGEMENT PLAN

(Deliverable 0301)

December 2, 1994

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